The

Electrical Review

VOL. XCVI. JANUARY 30, 1925. No. 2,462.

THE OLDEST ELECTRICAL PAPER. ESTABLISHED 1872.

Published every FRIDAY, Price 6d.

Chairman: H. ALABASTER.

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Telegraphic Address. "AGEEKAY, CENT., LONDON," Code, A B C. Telephone Nos.: Central 8290 and 8291.

The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

SUBSCRIPTION RATES, Postage Free: United Kingdom, £1 14s 8d.; Canada, £1 12s. 6d.; Colonial and Foreign, £2 1s. 6d. per annum Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, LIMITED, and crossed "Midland Bank, Newgate Street Branch."

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Increasing Production.

IN several of our issues during the latter part of 1924 we referred at length to matters of fundamental importance to the development of our industry. It is, therefore, of great interest to find that during the early weeks of this year some valuable practical contributions have been made by individuals tending in some of the directions mentioned in our leaders and articles on "Increased Production."

In connection with labour, we note that one of its leaders, Mr. Clynes, in an address to the Yorkshire Branch of the Industrial League, pointed out to workers the dangers of limitation of output, and the importance of allowing to that class of labour which starts with the greatest handicap the opportunity of attaining to higher grades if the will and ability to do so are there. If the men employed in the building trades would carefully consider this advice and give practical assistance in the present unfortunate position with regard to the shortage of houses and unhealthy conditions of living, many workpeople would be benefited, thus tending to remove a grievance and, therefore, to produce more satisfied citizens.

Mr. Clynes also referred to the prosperous condition of the workers in America, and agreed with the opinion expressed by us before, namely, that this has been very largely brought about by maximum effort on the part of the employé and a will on the part of the employer to see that the worker gets his due for those efforts.

In connection with our recommendation for the rapid development of electricity supply throughout the country, we find excellent justification for these suggestions in the American statistics for 1924, which reveal that the year was a record one in the United States in such development, enormous sums having been raised by power companies for extensions and new developments, whilst the interconnecting of the generating systems was carried very much further. As a nation, we should take particular note of the fact that

these steps were taken by Americans in a year when the prosperity of other industries there was rather decreasing than increasing. The result of this policy is that they now claim that 90 per cent. of the towns and villages have electricity supply available, and when one realises how far apart are the towns and villages and how thinly populated many parts of the United States are, this indicates very great progress. Further, it must not be thought that this development has taken place by way of hydro-electric installations, as the great majority of American power stations are steam driven.

A Bill will be brought before Parliament this session to authorise a power company to supply Bedfordshire, Cambridgeshire and Huntingdonshire, and we trust that this is only a forerunner of many other such schemes, for, as mentioned in our previous articles, we feel that this vital question of power supply has very great influence in this country on the development of industry, the decentralisation of labour, and the improvement in the conditions of the workers, ultimately bringing into existence a more settled and satisfied atmosphere in the ranks of labour.

It is also interesting to note that the Association for Education in Industry and Commerce at the Annual Conference of Educational Associations advocated the teaching of the economics of industry, and thus supported one of the recommendations in our articles. Several important representatives of the employers' side endorsed these proposals at the meeting held at University College, London, not necessarily because they were going to obtain personal gain, but rather in order to enable the workpeople to have a better understanding of the conditions that must prevail in industry to the advantage of both employer and employed. As the teaching of the general principles of economics spreads, co-operation between employer and employed must develop, as it will be realised that no ultimate gain can come from an atmosphere of possible and probable strikes or lock-outs. Consequently both sides will take steps to avoid the causes leading up to such serious dislocations of industry. Too much emphasis cannot be laid on the fact that the loss due to strikes is an item which has to be absorbed in the cost of production, either directly in the cost of the articles, or through rates and taxes which are inflated owing to the expenses borne by the public through our national insurance or poor relief channels, and we trust this view will be studied by both sides at the meetings that are being held between employers and employed in the engineering industry on wages questions.

Lastly, the need for an investigation of the percentage of the population who live by selling and shopkeeping rather than by production, cannot be over-emphasised, and steps should be taken in the Census of Production to obtain figures which will enable an analysis to be made of this important point, especially as this particular feature is responsible for the difference, which is enormous in many cases, between the cost of an article at the factory and its price when purchased by the ultimate consumer. This difference is not principally profit, but is due to the large selling expenses which accumulate on account of the number of hands through which distribution from the manufacturer to the consumer is at present accomplished. One reason for this growth of selling expenses is the tendency of so many able men to take up a selling position or an agency because they feel that the work is more congenial, and is additionally attractive because the monetary gains are greater than appointments on the productive side of industry. Manufacturers should give careful consideration to rectifying this state of things.

We would again urge the importance of each person making sure that in his own particular way he considers situations that he meets with from the point of view of the common good in addition to the natural consideration of his personal gain. The foundation of the improvement of the conditions of industry can be laid by each individual carefully analysing his own capabilities to remedy defects. To give an example, we know of a case where a designer, when faced with the problem of designing a machine to fulfil an order of large quantity, felt that if he could build a sample machine he could probably improve the weight efficiency by some small percentage, which would have given him considerable personal satisfaction, and avoided the necessity of taking any personal risk. It was pointed out to this designer that to do this—as there was no other work available for the workpeople—would have meant workpeople being thrown out of employment until such time as the experimental machine had been built and tested. Realising this, he decided to take a personal risk and put a design into the shops immediately for manufacture in order to keep the men continuously employed. This was an ultimate gain to both employer and employed, the former because he had not to carry losses on his standing charges due to the fact that his factory was not producing, and the latter because employment was more continuous. The designer as an individual took a small risk to the considerable benefit of industry generally.

An example of what managements can do similarly is the step taken to our knowledge by a firm in putting into its shops an order to manufacture for stock during a period of depression in order to give as many as possible of its employés continuous employment, as suggested in our articles for our coal and iron industries.

The Jointing of Metals.

INVESTIGATIONS of particular interest to electrical engineers are being carried out by the British Non-Ferrous Metals Research Association in connection with the jointing of metals and the qualities of high-grade lead cable sheathing. Valuable information has been obtained with regard to soft solders, and some of the points dealt with are the beneficial and deleterious effects of antimony in tin-lead solders, the mechanical properties of solders, the electrical conductivity of solders and soldered joints, the strength of soldered joints, the corrosion of solders, and the porosity and uniformity of strength of joints—all of which are vital points in connection with electrical jointing. The members of the Association have been invited to state in detail the nature of their work and the solder employed, and the investigators are prepared to advise them on what can be done to reap the benefit of the results so far achieved.

Considerable information has been accumulated on the question of the deterioration of cable sheathing, and progress is being made with the study of the mechanical properties of lead at low temperatures, in connection with the failure of the lead sheathing of electrical cables due to the apparently spontaneous development of cracks.

We are reminded of the interesting correspondence on "Plumbers' Wipes" which was carried on in our pages in February, March and April last, when the question of wiping a plumb joint with tallow brought forward instructive observations on the vital points of temperature, crystallisation, and porosity of the metal used. The temperature, of course, is controlled by the craftsman, but the mixture of metal is not always with his control—at any rate, not to an adequate extent. Crystallisation is essential in the process of cooling in the joint; but it may make or mar the state of porosity of the mixture according to the components and their relative proportions.

It is here that scientific research will prove of great value to all engaged in the maintenance of lead-covered cables, and we hope it may lead to a standard mixture being adopted in the production of plumbers' metal.

In some cases, it is true, particularly with cable manufacturers who prepare their own metal, it is made to a definite specification of mixture based on research or practical experience, but in very many cases the users of metal are left in the hands of wholesalers.

It may be well to mention here the effects of the use of

some "lining" materials used in making joints. Some black-lead and blacking mixtures have been found to have the effect in the course of a few years of making the ends of the joints porous—presumably they act chemically on one component of the mixture.

British Trade Marks and Their Protection.

In the pursuit of his foreign trade activities nothing more effectively arouses the wrath of the British manufacturer than the grossly unfair practices of which his foreign rivals are sometimes guilty. Occasionally infringements or underhand practices are so miserably immoral and yet so stupidly open and simple as to lead the British trader to mingle with his anger a fair measure of contempt for those who know no such thing as business conscience. Of course no business community in the wide world is entirely free from the type of man who, while he will not rob his fellows of his goods, will take mean advantage of his rights in other forms. But within our Home borders it is easier to bring the offender to book—when he is caught—than is the case when he is a foreigner manufacturing in one country abroad and carrying on competitive operations against us in another overseas market. Certain words, labels, marks, names of industrial centres, &c., become accepted the world over as standards or hall-marks of British quality; here is the opportunity so freely availed of in the past by pushful rivals in other countries to adopt them or slightly vary them for affixing to inferior manufactures produced at half the cost. British reputation is damaged and British trade is stolen—there is no milder term to apply to it. Patent rights are infringed, models and designs are copied, and false indications of origin are given—all of them practices which drag international trading relations into an atmosphere of pollution and suspicion. But wrath and indignation, contempt and disgust, on the part of well-meaning concerns, though they may give relief to the feelings, do not go far to practically meet the evil unless they evolve into the terms and spirit of measures taken to counteract, defeat or end it.

It is with the important object of securing amendment of the International Property Conventions that the big conference of representative trade and technical associations and other organisations was opened in London on Thursday, January 15th, and after a lengthy sitting adjourned for a week. It was convened by the Trade Marks, Patents and Designs Federation, and was attended by delegates from leading Chambers of Commerce, engineering institutions and societies, the Federation of British Industries (to which of course the electrical and engineering associations are affiliated), the British Science Guild, the Electric Lamp Manufacturers' Association, the Chartered Institute of Patent Agents, and many other bodies.

Many matters came under discussion, and among the resolutions passed was a comprehensive one dealing with the unfair use of marks, names, devices, trading styles, or other descriptions, when such use would cause either confusion with the wares of another person or error as to their real origin. The conference considered proposals for the amendment of the International Property Conventions which are due for revision at the Hague in October next. The various countries interested will be lodging their proposals by March, 1925, and as the Board of Trade is now considering the British recommendations, the conference has asked the Board to give it an opportunity of submitting its views before those recommendations are forwarded to the Dutch Government.

New Fields for Electrical Contractors

In a speech at the annual dinner of the Electrical Contractors' Association last week, the president, Mr. Walter Riggs, who combines contracting with farming, gave free play to his enthusiasm for the application of electricity to agriculture. As reported elsewhere in this issue, he showed what a vast potential field of operations the electrical contractor should find in rural areas when a supply of electricity became available there, and looked to the development policy of the Electricity Commissioners for the key to this new business. As consistent advocates of electrical farming for the last quarter of a century, we welcome Mr. Riggs's efforts to arouse interest in it, and his statement that the farmer of to-day is not the hide-bound conservative that he is often represented to be, but is wide awake to the possibilities of electric power. Mr. Borlase Matthews's experiences, as recorded in our pages, have shown that farmers are eager to obtain information of this nature, and Mr. Riggs pointed to the extensive networks of mains in country districts on the Continent as evidence of their practical appreciation of electrical aids. Not only contractors, but also supply authorities, and manufacturers of motors, cable, switchgear, and generating plant are equally interested in the opening-up of the "electrical field," and ought to support the movement to the utmost of their ability.

Gas and Electricity.

We have often used the title "Electricity *v.* Gas," when referring to these rival commodities, but it seems that the time is coming when we shall prefer the title given above. Indications are multiplying that gas engineers would welcome a *rapprochement*, and electrical engineers, judging by the remarks of Mr. W. B. Woodhouse in his presidential address to the I.E.E., are by no means averse to co-operation with their competitors.

As an instance of this pleasing drawing together, we may cite the incident which took place at the Institution of Electrical Engineers on Thursday last week, when a deputation of members of Council of the Institution of Gas Engineers, headed by their president, Mr. J. Ferguson Bell, M.Inst.C.E., was received by Mr. Woodhouse at the opening of the meeting, and Mr. Bell presented to the I.E.E. a framed certificate of presidency recording the work of Dr. Alexander Russell during his year of office, together with the plate from which it was printed, in recognition of the hospitality afforded by the I.E.E. to meetings of the Gas Engineers at its Embankment home. Mr. Bell made a friendly speech, in the course of which he claimed that there was plenty of room for both electricity and gas, and stated that the development of the latter had been immensely stimulated by the advent of the former; while Mr. Woodhouse, accepting the gift and welcoming this evidence of goodwill, acknowledged that the prior invention of gas had paved the way for the introduction of public electricity supply.

In the House of Commons in December, during the debate on the King's Speech, Mr. R. G. Clarry advocated co-operation between the two great industries, in the public interest and in order to economise fuel as a national asset; coal conservation and electrical development could best be dealt with by active co-ordination between the sister industries, and he suggested that a case could be made out for inquiry into the subject. Our contemporary, *The Gas World*, endorsed Mr. Clarry's proposals.

There are already a few cases in which gas and electricity are supplied by the same company, gas engines being used to drive the electrical generators; and many municipalities supply both gas and electricity, but run the undertakings on entirely independent lines, though they do not permit unrestricted competition between them. Moreover, many gas undertakings use electricity freely for lighting and power in their own works. Up to the present we do not know of any instance of the complete and purposeful combination of the two businesses, but we have reason to believe that the gap will shortly be filled, and once a start is made, we look for rapid progress in their better co-ordination. We have many times referred to the desirability of this policy, and we hope that it will soon take practical shape.

Pre-Heated Air in Modern Boiler Plant.

By CHARLES ERITH, A.M.I.Mech.E.

For hand-fired cylindrical boilers at sea, using forced draught, it is highly advantageous to draw the air for combustion through flue-gas air preheaters, both because it is rarely practicable to adopt on ships the alternative method of recuperating heat from waste gases by a flue-gas feed-water heater or economiser; and also because preheated air gives a substantially higher temperature of combustion in hand-fired, water-lined furnaces, thereby improving the boiler efficiency.

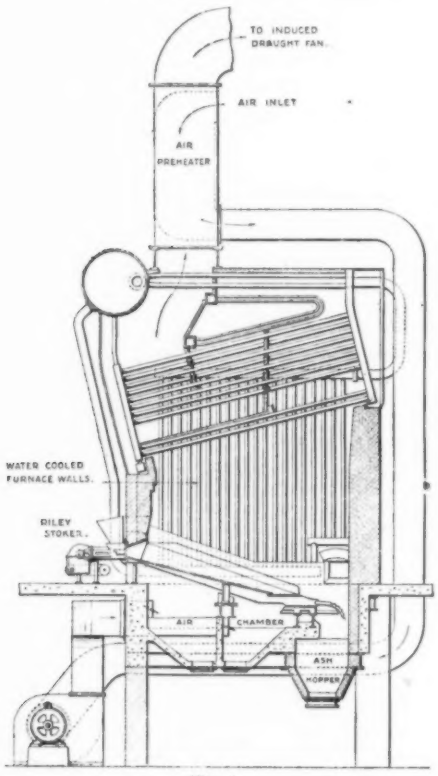


Fig. 1.

But with mechanical firing with retort-type stokers, both at sea and on land, and whether using cylindrical or water-tube boilers, maximum boiler efficiency is easily maintained either with water-lined or with brick-lined furnaces, and then the fuel saving merely corresponds to the heat units recuperated from the relatively small quantity of waste heat available in the exit gas. This fact was demonstrated on a large steamship fitted with Yarrow marine water-tube boilers, wherein the steeply-inclined banks of water tubes formed the sides of the triangular furnace, their function being similar to that of the water legs of a locomotive-type boiler. The adoption of retort-type stokers greatly improved the boiler efficiency, while naturally reducing very considerably the available heat in waste gases reaching the tubular air preheaters; and the gas analysis showed excellent combustion with either cold or hot air.

Fig. 1 shows a recent application of marine-type practice to a large unit stationary water-tube boiler unprovided with an economiser, and fired with a Riley multiple-retort stoker; additional boiler heating surface is provided in the form of water-cooled side walls forming part of the boiler circulation, the lower headers forming mud drums, and therefore being protected by firebrick walls, except where they are below the level of the inclined grates of the stoker.

The heat absorbed by such additional boiler heating surface in the form of water-cooled side walls is not very considerable, as was recently proved by an experiment at the Waterside station of the New York Edison Co., where a furnace 12½ ft. wide under a 6,000-sq. ft. Babcock boiler fired by a seven-retort stoker was fitted with a pair of water legs, each composed of a steel box about 4 in. deep, and exposing a total of 140 sq. ft. of water-cooled surface to the fire. At about 200 per cent. American rating, *i.e.*, at, say, 36,000 lb. steam × 1,200 = 43,200,000 B.th.u. absorbed hourly by the boiler, the two water legs absorbed 43,000 B.th.u. per sq. ft. × 140 sq. ft. = 6,020,000 B.th.u., or, roughly, 14 per cent. of the total heat transferred under excellent conditions of fuel and combustion. For this experiment the water-legs were not connected to the boiler circulation, so that this percentage of heat absorption by the water-cooled walls could be accurately measured. It was found that these water-legs, extending down to the stoker line, cooled off the fuel bed for about a foot on each side of the 12½-ft. wide furnace, whereby considerable quantities of unburnt coal were discharged to the ashpit at those points. But with the tubular water-legs, as shown in fig. 1, this trouble will not arise, as brick side walls are used where the lower headers or mud drums are above the grate surface.

The extension of the boiler-heating surface in the form of water-tube walls is extremely costly, in view of the small proportion of the heat which they can absorb, particularly in the wide furnaces of modern large-unit boilers; but the object in view is to withstand the excessively high furnace temperatures obtainable either with oil, pulverised coal, or solid-fuel firing, in the attempt to get maximum thermal efficiency for

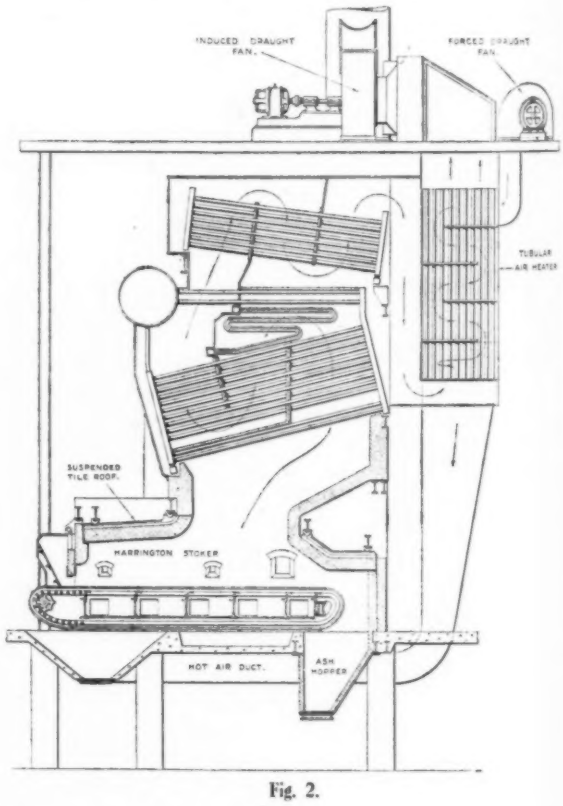


Fig. 2.

boilers which are unprovided with economisers, as is the case in many American central stations. In such cases it has recently become usual to compensate for the reduction in water capacity by adding many extra rows of boiler tubes; but although such extra rear heating

surface cools the exit gas somewhat nearer to the steam temperature than a normal boiler can do, the overall efficiency under equal conditions of combustion must always be inferior to that where the same total heating surface and water capacity is divided between the boiler and economiser.

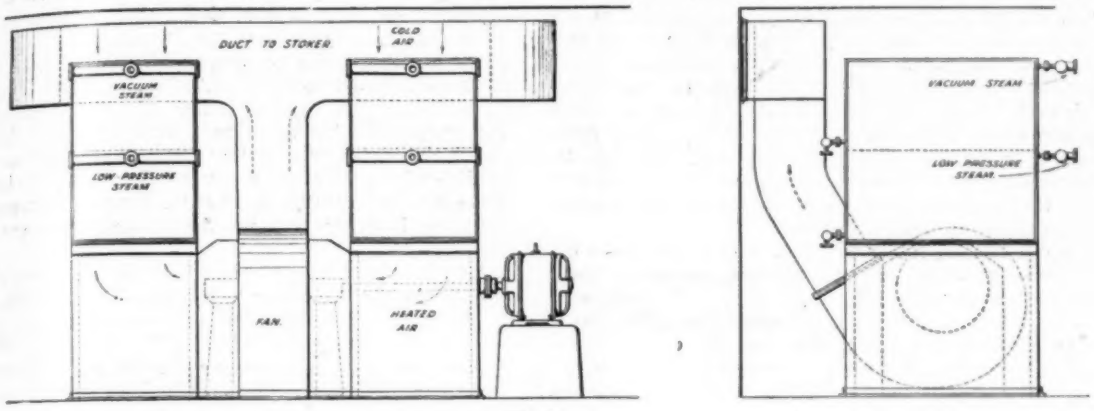


Fig. 3.

Thus, at the Colfax plant at Pittsburgh, each Babcock boiler has 20 rows high of tubes, totalling 22,914 sq. ft. boiler heating surface over each 17-retort stoker; the great bulk of the heat is, of course, absorbed by the two bottom rows of tubes, but with 275 lb. steam pressure, involving 415 deg. steam temperature, the gases leave the boiler at only 482 deg., and under such conditions only 2.8 per cent. extra efficiency can be got by cooling the exit gas through 179 deg. to 303 deg., as proved by recent tests with a flue-gas air preheater of 11,200 sq. ft.

An apparent further gain, on these tests, of 3.14 per cent. extra efficiency was attributed to better combustion, and it was suggested that this was due to reduced combustible in the ash; but this suggestion seems very doubtful, as under proper supervision the heat loss by combustible in ash from any good mechanical stoker is extremely small when using unheated air for combustion; and on recent tests at the Chicago Edison plants, no such gain was claimed when using preheated air under mechanical stokers, and the gain in thermal efficiency corresponded merely to the heat units recuperated in preheating the air with waste gases.

Fig. 2 shows a modern application of a flue-gas air preheater to a boiler having the usual economiser. Experience has quite justified Sir James Kemnal's statement in his paper of June, 1923, to the Institution of Mechanical Engineers that an economiser containing 50 per cent. of the boiler heating surface would add about 6 per cent. to the boiler efficiency, bringing this up to 82 per cent. on the higher calorific value of the coal, and that a flue-gas air preheater containing 100 per cent. of the boiler-heating surface was required to add about 2½ per cent. efficiency. Assuming, for instance, a 10,000-sq. ft. boiler with a 5,000-sq. ft. economiser giving 82 per cent. efficiency on the gross or true calorific value of the coal (or, say, 85 per cent. on the net or lower heat value), the question is whether a possible increase of 2½ per cent. efficiency (without deducting working cost) can justify the addition of a flue-gas air preheater.

In a recently-published test at The Hague, Holland, of a 6,725-sq. ft. Babcock boiler, with a 5,130-sq. ft. economiser, the exit gases left the economiser at 392 deg. and entered a 7,525-sq. ft. flue-gas air preheater, which reduced the gas temperature to 316 deg. by heating the

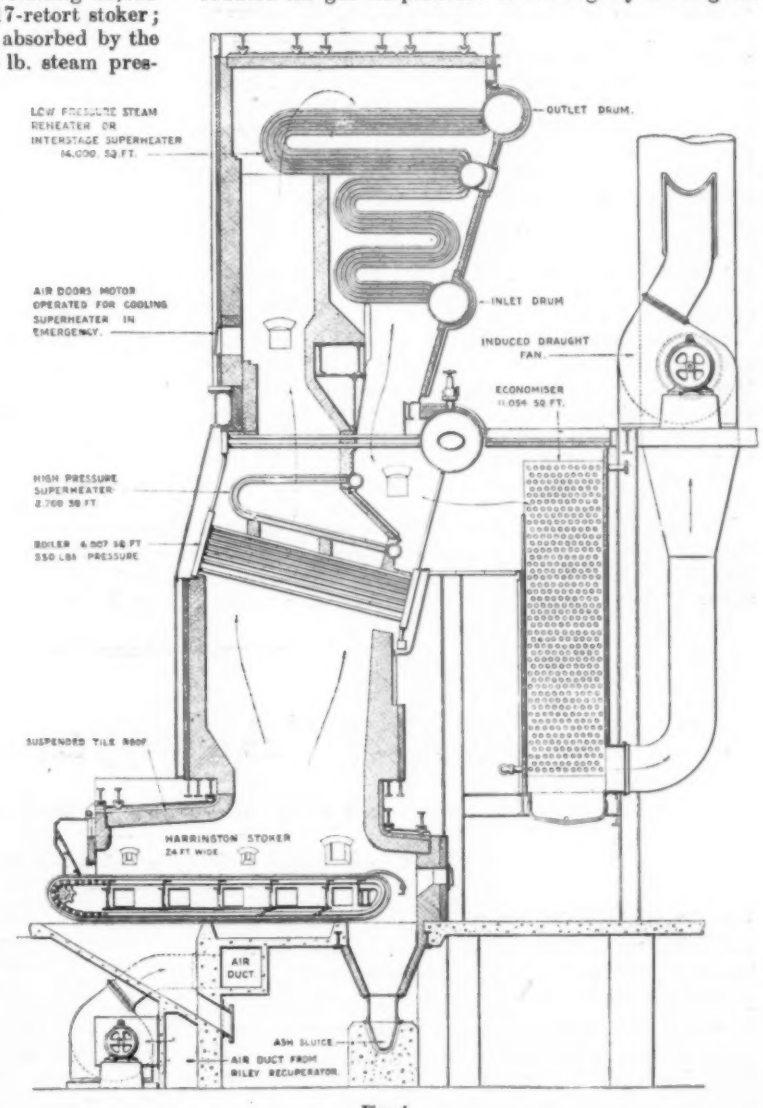

LOW PRESSURE STEAM REHEATER OR INTERSTAGE SUPERHEATER 14,000 SQ.FT.
AIR DOORS MOTOR OPERATED FOR COOLING SUPERHEATER IN EMERGENCY.
HIGH PRESSURE SUPERHEATER 8,700 SQ FT
BOILER 6,807 SQ FT 350 LBS PRESSURE
SUSPENDED TILE ROOF
HARRINGTON STOKER 24 FT WIDE
AIR DUCT
ASH SLUICE
AIR DUCT FROM RILEY RECUPERATOR
OUTLET DRUM.
INLET DRUM
INDUCED DRAUGHT FAN.
ECONOMISER 11,054 SQ FT.

Fig. 4.

combustion air through 88 deg., *viz.*, from 79 deg. to 167 deg. Fahr., involving 2.2 per cent. added efficiency.

In his recent presidential address to the Institution of Electrical Engineers, Mr. W. B. Woodhouse pointed

out that the total costs of electric power production were normally: coal 50 per cent.; capital charges 30 per cent.; operating costs 20 per cent.; from which their relative importance may be judged.

Ignoring for the moment the extra power cost on the balanced-draught fans when flue-gas air preheaters are added, it is clear that a 10,000-sq. ft. flue-gas air preheater, adding at most 2½ per cent. efficiency, is a poor investment compared with a 5,000-sq. ft. economiser which adds 6 per cent. to the boiler efficiency, as stated by Sir James Kemnal; and that 2-stage feed-water heaters, raising the feed-water to, say, 200 deg. by recuperating latent heat from expanded steam drawn from the low-pressure stages of the turbine or engine, are an extremely good investment.

An economiser, fed at 200 deg., will usually raise the feed-water to about 300 deg. by recuperation of waste heat from a normal boiler; but while it is possible to add a third stage of steam-heating and thus deliver feed-water to the economiser at 300 deg. F., it is obvious that this is carrying steam feed-heating too far, as then the temperature of the exit gas from the economiser will be unduly high.

Experience having shown conclusively that preheated air at about 200 deg. F. is quite unobjectionable for modern mechanical stokers and for their refractory furnace settings, the author has recently secured a provisional patent and has introduced the Riley recuperator, shown in fig. 3, whereby expanded steam drawn from the low-pressure stages of the turbine or engine is utilised for multi-stage heating of the air for combustion in balanced-draught furnaces, whether for solid fuels on mechanical stokers of any type, or for oil or for pulverised coal firing. This compact and inexpensive appliance is placed in any convenient position, but is preferably grouped with the double-inlet forced-draught fan, as shown in fig. 3, and forms a duplex aero-condenser transferring the latent heat of expanded steam (otherwise dissipated in the condensing water) to the air for combustion, and involving no appreciable working cost; the pure hot water of condensation flows to the feed-water tank.

The additional power for the fan, when handling air preheated to, say, 200 deg. F., is only about one-fourth of 1 per cent. of the electric power developed; either a fixed-speed or a two-speed a.c. motor is generally used, and the volumetric capacity of the fan is, of course, arranged for air at, say, 200 deg. F., when its volume is 28 per cent. more than for atmospheric air at 60 deg.

Alternatively, an existing forced-draught fan, designed for unheated air supply, can be arranged to blow through a Riley recuperator to the air chamber of the stoker, using a somewhat higher-speed motor to compensate for the slight frictional loss involved in the Riley recuperator.

Fig. 4 shows the reheater boiler unit for a proposed 60,000-kilowatt turbo-generator, to use steam at 550 lb. steam pressure, superheated from 482 deg. to 725 deg., supplied by five boilers each with a Harrington stoker, 24 ft. wide and 20 ft. long, 480 sq. ft. grate surface, with a suspended tile roof. Four of the boilers are to have 15,000-sq. ft. boiler heating surface each; but the fifth boiler unit is as shown, with the upper tube bank omitted, and with only 5,000 sq. ft. boiler-heating surface, so that the bulk of the available heat of this unit can be absorbed by the large secondary superheater or reheater for partly-expanded steam in its travel towards the low-pressure stages of the turbine.

Low-pressure steam will be drawn in two stages, both for heating the feed-water to 200 deg. F. before delivery to the large economiser, for final heating to, say, 300 deg. F. by waste gases which will leave the boilers at about 600 deg. and the economisers at about 350 deg.; and also for preheating the combustion air for the Harrington stokers to about 200 deg. F. in Riley recuperators, as shown in fig. 3; this applies to all five boiler units.

Whatever the boiler pressure and superheat adopted, and whether using unheated or preheated air, these modern stokers, worked at 12 per cent. CO_2, and therefore without excessive furnace temperatures in their brick-lined furnaces, will assure 82 per cent. thermal efficiency on gross calorific value of normal coals over the whole range of load (or, say, 85 per cent. on net calorific value), with extreme reliability, low capital charges, and minimum working cost for the stokers and for the balanced-draught fans.

On expert tests with selected fuels it is quite possible to work at 16 per cent. CO_2, thereby gaining a further 2 per cent. on the thermal efficiency obtained at 12 per cent. CO_2 as above; but the excessive temperatures corresponding to 16 per cent. CO_2 with any firing method require heavily-increased capital charges for water-cooled furnace walls, and frequent stoppages for costly repairs and renewals.

In striking contract to the small possible recuperation of waste heat by a flue-gas air preheater, the recovery of latent heat from expanded steam in the Riley recuperator, in heating the combustion air from 60 to 200 deg. F., involves a substantial saving in the fuel bills without appreciable working cost, while the capital cost is very moderate, and the upkeep charges are entirely nominal.

In cases where the firing method is defective, further fuel savings can be made by better combustion due to preheated air.

The "Aerodynamo."

A New Wind-Power Machine.

By A. J. V. UNDERWOOD, M.Sc., A.M.I.Chem.E.

THE question of the utilisation of natural power resources, which has always evoked interest since the beginnings of civilisation, is increasing rapidly in importance as the rate of consumption of the fuel resources of the world increases. Both water power and wind power have been used for many centuries through the primitive agencies of water-wheels and windmills. Whereas the developments of the last fifty years in the utilisation of water power have raised this branch of hydraulic engineering to a science in itself, methods of utilising wind power have, with minor exceptions, progressed inconsiderably until recently, and it is probable that the total horse-power at present derived from the wind is less than it was fifty years ago.

On this account it is interesting to learn that a new wind power machine which has been developed in Germany embodies considerable technical advantages over earlier machines, and promises to make the general utilisation of wind power a feasible proposition in places where other sources of power are not available. One of the obstacles that have hitherto hindered the developmen of wind-power machines has been the difficulty of combining the essential factors of high efficiency and robust construction to resist any possible damage by gales. The ordinary windmill is strongly constructed, but has a very poor efficiency, and many other

types of wind motor that have given greater efficiencies have not been successful in eliminating the liability to damage by high winds.

The new type of wind motor, which is known as the "Aerodynamo," is designed so as to embody the knowledge and experience that have been acquired in recent years of the aerodynamic problems relating to aeroplane propellers and resistances. The "propeller" of the "Aerodynamo" has four blades. Experiments have been made with a two-bladed propeller, but it has been found that smoother running is obtained with four blades, and a smaller span is necessary for the same

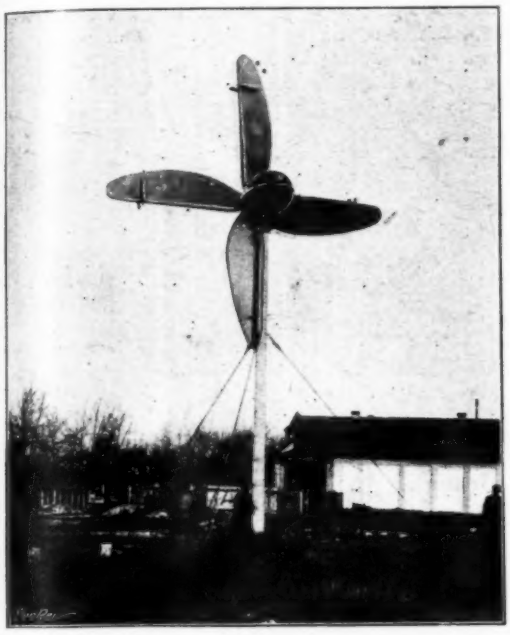


Fig. 1.—The "Aerodynamo."

power. The shape of the blades has been arrived at after considerable experimental work on various forms in a wind tunnel. The present shape is that which was found to give the greatest efficiency.

In order to transform the energy of the wind into electrical energy, a generator is geared to the propeller shaft directly, thereby avoiding bevel drives and long shafts. The generator and gearing are enclosed in a hood which is of streamline shape. A departure from previous practice is made by placing the propeller behind the generator and supporting structure. By this means the necessity of providing a guiding vane to keep the machine in the wind is avoided, and it is claimed that better efficiency is also obtained. As the machine is carried on a slender reinforced concrete pole and the generator is enclosed in a streamlined casing, any interference of these parts of the machine with the air currents is negligible.

In order to avoid excessive speeds of rotation of the propeller during high winds, patent air-brakes are fitted on the blades. These consist of small vanes (see fig. 1), which are held by springs of suitable strength in such a position that at ordinary speeds of rotation they offer no resistance to the air, as their planes are parallel to the direction of rotation. At higher speeds, centrifugal force causes these vanes to alter their inclination to the direction of rotation so as to offer the resistances of their plane surfaces to the rotation of the propeller. In this way a limit is placed to the maximum speed of rotation of the propeller even in the highest wind. By means of these brakes, which are not liable to become heated or to wear, damage by gales is prevented. Since aeroplane propellers are made to withstand much greater stresses than would arise in the wind motor, there is no difficulty in constructing the latter of sufficient strength, especially as the question of weight is not of such importance in a land machine as in an aeroplane. An additional brake is provided on the propeller shaft in case it is ever required to stop the rotation of the machine completely.

The reinforced concrete mast on which the machine is mounted is considerably cheaper than a lattice tower, and causes less interference with the air currents. In addition, it facilitates enormously the erection and transport of the machine, which can be erected or removed from one place to another in a few hours.

A storage battery is provided against the periods when there is no wind, and its size is determined by local conditions and requirements. Even in a very moderate wind, the power generated is quite considerable, as will be seen from the figures given below. Several special features are incorporated in the electrical portion of the installation. The generator, which will not normally run at above 1,200 r.p.m., is tested up to 3,000 r.p.m., in case of any unexpected failure of the brakes. An automatic regulator is also provided to prevent "motoring" of the dyuamo by the storage battery when the wind drops. This regulator completes the circuit as soon as the voltage of the dynamo reaches that of the battery, and breaks the circuit when the voltage falls too low.

The storage battery is divided into two parts, and can be charged in parallel through resistances, or in series with the resistances cut out by means of a switch. A third position of the switch cuts out the storage battery from the circuit altogether, so that power is then taken directly from the dynamo. The general arrangements are shown diagrammatically in fig. 2.

The machine shown in fig. 1, which was recently tested near Berlin, has a mast 30 ft. high, and the length of the blades (from tip to tip) is 28 ft. The rated output is 10 kilowatts, or 14 horse-power, and the following figures give the power developed at various wind speeds at the preliminary tests:—

Wind velocity, miles/hour.	Horse-power.
6.5	3
11	12
18 and over	14

This machine is to be erected at the Institute of Agricultural Engineering at Oxford, where extensive trials

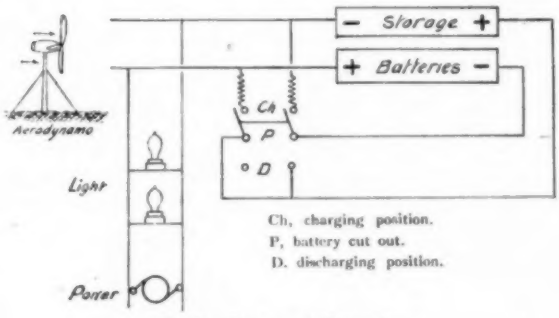


Fig. 2.—Diagram of Connections.

will be carried out, and the results will be awaited with interest in view of the wide applications of a successful machine for agricultural and domestic purposes in places where other sources of cheap power are not available.

Light at the Zoo.—Casualties are reported from the London Zoo, where fog often proves fatal to weakly tropical birds. Nearly all the birds go off their feed through lack of light and sunshine, and their reduced vitality is not improved by sulphurous impurities in the air. Still, a healthy, hungry bird should have the strength to resist fog, and so, says the *Daily Mail*, fogs are to be fought in the tropical bird-houses by the installation of quartz electric lamps, which do not cut off the stimulating ultra-violet rays. This form of artificial sunshine should keep the small birds feeding and so give them strength to go on living. Snakes and lizards in the lighted Reptile House laboratory make every effort to crawl into the rays and show signs of recovering their appetites. An electric main is to be laid down the Broad Walk in Regent's Park, and from this the Zoo hopes to bring light to the cages where it is most needed.

The Design of an "All-Purpose" Broadcast Receiver.

By R. ROBERT.

THE ideal broadcast receiver, from the point of view of the average non-technical listener, would be a receiver having but a single control; a large dial, say, with the names of the various stations engraved round its circumference, which would bring in, at the fraction of a turn, any desired broadcast transmission. Unfortunately, this ideal is not, as yet, quite realisable, and in order to attain a reasonable efficiency, one has to be satisfied with something less. Roughly speaking, the up-to-date broadcast receiver should embody the following features:—(1) It should be compact and, so far as is possible, self contained; (2) it should be simple to operate; (3) it should be selective and powerful. In the short article to follow, the writer hopes to give some few indications as to how these ends may be arrived at in actual practice.

The question of making a set as compact and as self-contained as possible is very largely decided by the choice of a suitable containing cabinet. This should be neat, made of a good quality wood, and so designed that there is no need for any external connection beyond the essential aerial and earth, loud-speaker, and perhaps "low-tension." The operating panel should contain nothing beyond the condenser dials and the various switching controls. Coil holder, valves, and other accessories should be mounted at the back of the panel where they are out of sight, and protected from dust and accidental knocks. There should be a lid at the top of the cabinet so that accessories may be inspected or replaced at any time, and folding doors may be fitted in front of the panel so that once the set has been adjusted it may be closed up and become an unobtrusive article of furniture. A small drawer fitted in the bottom of the cabinet would serve to accommodate the high-pressure and possibly the low-voltage batteries. To fulfil the condition of compactness, the dimensions of the cabinet should be kept as small as possible without unduly crowding the various component parts together. Proceeding upon the above lines, it is possible to build up an exceedingly neat and attractive type of cabinet, external connections being reduced to an absolute minimum.

Regarding a suitable circuit design, this is often a matter presenting considerable difficulties. The demand of the average man is for an "all-purpose" receiver that will get him his local station on the loud-speaker and other stations, British and Continental, on the headphones, with the minimum amount of manipulation. He wants power and selectivity, but does not want to turn more than a couple of knobs; his apparatus must, therefore, be as free as possible from all unnecessary complications.

At first sight, it might appear that the ideal receiver would be one of the "reflex" type; that is, a receiver in which the principle of dual amplification was made use of. Certainly, some of the improved types of "reflex" circuit, such as the S.T.100, possess many excellent features. They are extremely simple to operate, a minimum of battery power is required, two valves performing the work of nearly four, and the quality of reproduction, provided the right components have been used, can be extremely good. The disadvantages attached to the use of reflex circuits are, however, considerable. They are inclined to be somewhat erratic and unstable in their behaviour, are not very effective for reception over long distances, and the customary crystal detector is—with all due respect—apt to become somewhat of a nuisance.

For an "all-purpose" receiver, able to bring in distant stations with ease and regularity, the present writer would suggest the following:—A four-valve set comprising (1) high-frequency amplifier; (2) detector; and (3) two stages of low-frequency amplification. Controls would be reduced to an absolute minimum. Starting with the antenna circuit, this might consist of a single-circuit directly coupled to the grid of the h.f. valve and tuned by means of a condenser in parallel—this arrangement obviating the use of a series-parallel switch. Double-circuit tuners, although extremely selective, are apt to be troublesome to the non-expert, and are, therefore, to be avoided. The h.f. valve might be tuned-anode coupled and provided with either "neutrodyne" or potentiometer control. A telephone jack would be placed in the anode circuit of the detector valve, and this would assist "tuning in," and enable one to listen to the local station on the headphones. A separate filament rheostat would be provided for each valve, the remaining controls being as under: (1) Two switches for cutting in and out the low-frequency valves; (2) a double-pole switch for cutting off both high and low-pressure batteries. A rough sketch of the arrangement is given in fig. 1. This is, of course, a mere tentative suggestion, but it is undoubtedly along these lines that a reliable "all-purpose" receiver is to be evolved—a straight-forward circuit arrangement combining maximum flexibility with the least possible number of controls.

The above type of receiver, whilst reasonably selective, would require some modification where jamming or in-

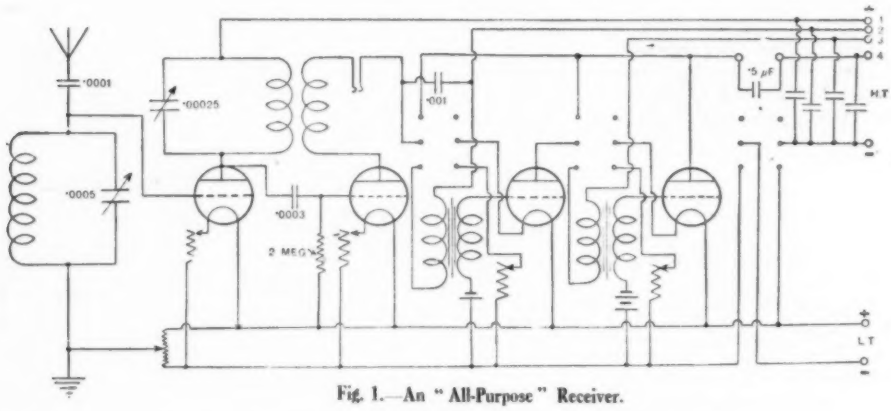


Fig. 1.—An "All-Purpose" Receiver.

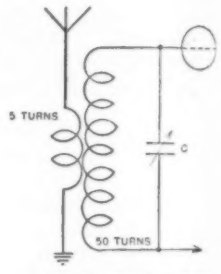


Fig. 2.—Semi-aperiodic Coupler.

terference from Morse stations was experienced. The latter is, indeed, one of the most serious problems that the designer of broadcast apparatus is up against. In some of the coast towns, for instance, interference from shipping is so bad as to make reception of the broadcast concerts almost an impossibility. In such instance, the design of the tuning circuit calls for some considerable care and ingenuity. An arrangement that will give exceptionally critical tuning without adding to the number of controls is the semi-aperiodic coupler shown in fig. 2. The aerial inductance consists of a few turns of wire only, closely coupled to a secondary circuit tuned by the condenser C. More selective still, but as already hinted, more difficult to manage, would be a system of loose-coupling. This, in conjunction with some form of wave-trap and careful attention to the conditions at the receiving antenna, should do much towards overcoming the particular difficulties associated with "jamming."

A point that will to some extent influence certain details in the design of one's receiver is the available battery power, and the type of valve it is proposed to use. Roughly speaking, at the present moment, there are three distinct types of valve open to choice: (1) The .06 dull emitters which can be made to operate upon ordinary dry cells; (2) the bright-emitter valves which require from .6 to .7 ampere at 4-6 volts; and (3) the D.E.R. type with a current consumption of from .25 to .4 ampere at 2 volts. It is sometimes a puzzle to know which type of valve to adopt. The pros and cons of the matter may be briefly weighed up as follows:—The .06 dull emitters are extremely economical as regards current consumption, but they suffer from the following disadvantages:—They are inclined to be somewhat erratic in their behaviour, particularly when operating upon the ordinary type of dry cell. They are extremely microphonic, and are not of much use where really first-class reproduction by the loud-speaker is required. Also they are expensive. The bright emitter valve has the disadvantage of a heavy filament consumption, but, on the other hand, it is reliable, extremely robust, the emission is heavy, and the cost is only half that of the dull-emitter valve. Where there are any facilities whatever for recharging an accumulator there should be no hesitation about adopting the bright-emitter valves. Where the battery problem is serious and yet not acute—where it is possible, say, to visit a near-by town once a month to collect an accumulator—the D.E.R. type of valve is to be recommended. Four valves of this type would consume just over an ampere, and with a 2-volt, 80-ampere-hour accumulator it would be possible to work for three weeks or a month on one charge. The performance of the D.E.R. valve, both as regards volume and quality of reproduction, is extremely good. Where there are no facilities whatever for accumulator charging, one is able to fall back upon the .06 dull emitters. One or two other types of dull emitter valve are on the market, such as the Wecovalve, which has a filament consumption of .25 ampere at .9 to 1.1 volts. This is an extremely neat and robust little tube, but at .25 ampere it is not really suitable for operation on a single dry cell. The most important details influenced by the type of valve chosen will be the ratio and impedance values of the low-frequency transformers.

Some minor points to be observed in the design of a successful "all-purpose" receiver are as under:—The leads to the high-frequency valve must be kept as short as possible. Component parts should be arranged so that all undesirable interaction effects are obviated. L.f. transformers (which, by the way, should be of the shrouded pattern) should be placed with their cores at right-angles to one another. External connections, such as those to aerial and earth, are best effected by means of suitable plugs and sockets at the back of the set, not on the front panel which is apt to become overcrowded. The ebonite panel upon which the various component parts are mounted should be so arranged that it can be slipped out of the containing cabinet at any time should inspection become necessary.

Switchgear Specifications and Tenders.

By J. REED WILKINSON, B.Sc.(Tech.)

LIFE has always been too short. That was the cry even in the leisurely Middle Ages, and it is reiterated to-day with increased emphasis. It is, therefore, not surprising to find that at long last consulting engineers are rebelling against the labour involved in tabulating, comparing, and dissecting some of the long-winded tenders which now appear to be the rule. The writer recollects a recent instance where one tender with its accompanying specification amounted to almost two hundred quarto typed pages. If one assumes that similar offers were received from five other manufacturers, the luckless consultant was faced with the Herculean task of closely examining over a thousand pages of typed matter, and picking out all variations and discrepancies.

In many other spheres it has been found that a revolt from one extreme has led to a complete swing of the pendulum, and the advocacy by the rebels of the other extreme. This has also been the case in this instance, and we have had eminent consulting engineers advocating tenders which were to consist merely of a string of figures, a schedule of points in which the gear offered definitely differed from the requirements of the specification, and the statement that "with the above exceptions the gear will be entirely in accordance with your specification." This, though apparently simple in theory, has many practical disadvantages.

Take, for instance, a simple specification calling for draw-out truck type switchgear. There are several makes of this class of gear which would fully comply with the specification. Each make would, however, have certain minor differences in design which might well determine the destination of the order. Under the scheme advocated above the various makers would be precluded from pointing out these differences, and this would have to be left to an interview, always provided that the tenderer was fortunate enough to obtain one.

Again, it is quite conceivable that although the manufacturer may not have a standard line exactly in accordance with the specification, yet he may have specialised in a different type of gear which he considers is as good or even better for the particular purpose. To bring this fully before the prospective purchaser would, however, mean a detailed explanation, and this is ruled out of order by the champions of brevity.

Lastly, and here the mere technical sales engineer must walk warily and with great trepidation, it is possible that the engineer who prepared the tender, and who has devoted his whole career to the study of switchgear problems, may have as great a knowledge of switching schemes as the consulting engineer who issues the specification, and may not agree that the scheme embodied in the inquiry is the one most suited for the particular requirements. This would be rank heresy to a consulting engineer, and to save his "amour propre" an offer would certainly be submitted in line with the specification, but any alternative scheme put

forward would need elaborating and justifying at some length.

This rather leads us on to the question whether the length of a tender depends entirely on the tenderer. Experience tends to show that it is governed to a great extent by the type of specification to which tenderers are asked to quote. It is to be doubted whether the ideal specification ever has been or ever will be issued. So long as human nature varies, so long will opinions differ as to what constitutes an ideal switchgear specification. We may, however, say that, broadly speaking, specifications fall into two distinct classes— those that explain everything and those that give only the broad outlines. Before dealing with the relative advantages and disadvantages of these two types it might be advisable to discuss the central features which should be embodied in all specifications from the smallest to the largest.

It may be considered superfluous to remark that in all cases the voltage, phase, and frequency of the system under consideration should be plainly stated. It is really surprising to note the number of inquiries which omit this all-important information or relegate it to some obscure corner. One receives many inquiries for "low-tension" switchgear with no specific voltage mentioned. This is more or less immaterial if the current carrying capacity of the gear is definitely stated, but when the inquiry further calls for gear for controlling a circuit of, say, 150-h.p. the luckless estimator is faced with the alternatives of assuming a voltage of 550 and putting in a 150-amp. switch, or assuming a voltage of 110 and offering a 750-amp. switch. Furthermore, the little god who looks after the estimating engineer invariably decrees that whichever alternative he takes is the wrong one. Another common fault in connection with two-phase systems is the omission to state whether the system is two-phase, three-wire, or two-phase, four-wire. It will, of course, be appreciated that this is one of those little distinctions which make quite a considerable difference.

One of the chief factors affecting the size of switchgear on e.h.p. switching systems is the rupturing capacity required for the oil circuit breakers. It cannot be stressed too much that unless the switchgear manufacturer is given adequate information on this point it is impossible for him to put forward gear which will be satisfactory for the duty required, and at the same time competitive in price. It should be borne in mind that at the present day the cost of e.h.p. switchgear for 6,600 and 11,000 volts is roughly proportional to the short-circuit rupturing capacity of the oil circuit breakers embodied therein.

In many cases the engineer who has drawn up the specification is in a position to state definitely what rupturing capacity he requires. For instance, a number of large municipal undertakings have standardised the breaking capacities of their sub-station switchgear irrespective of the relative positions of the sub-stations and the power house. On the other hand, whilst realising the advantages obtained by standardisation of equipment, other supply authorities prefer to adopt the more scientific method and grade the size of oil circuit breaker according as it is adjacent to or distant from the main power supply. In all these cases, however, it is customary for a definite rupturing capacity to be called for in the inquiry. Similarly, with the majority of large switching schemes involving plant capacities of, say, 30,000-kW and over it will be found that the engineers responsible for the scheme have given full consideration to the various arrangements of gear, use of reactances and so forth, and have reached a definite conclusion as to the size of gear which would best combine safety, efficiency, and economy. In such cases the specification states the rupturing capacity required, and the estimating engineer, with an inward sigh of relief, merely works to the figures given.

Instances arise, however, when the purchaser does not wish to take the responsibility of deciding the necessary rupturing capacity. In such cases it is essential to give tenderers the fullest data possible with regard to the generating capacity of the plant, and the position of the switchgear in the system. If possible, the specification should be accompanied by a line diagram of the system, which will probably be more valuable than pages of explanation. The capacity and reactance of all generating and transforming plant should be given together with the length, disposition and cross section of all interconnecting cables. Where several stations are interconnected the maximum power transference from one station to another should be stated. Where reactances are in use to limit the short-circuit currents, their values and method of connection should be clearly indicated. In addition to giving these particulars for the gear actually in hand, mention should be made of any extensions or linking-up schemes contemplated during the lifetime of the switchgear as this may have an important bearing on the size of circuit breaker finally adopted. If the above list of requirements seems rather formidable, it should be remembered that the satisfactory operation of the gear under fault conditions will depend to a large extent on the correct correlation of these requirements, assuming, of course, that the protective gear has also been carefully chosen.

Apart from the question of the rupturing capacity of oil circuit breakers, the position of the gear in the distribution network will have a considerable influence on the class of apparatus, and also on the type of protective gear to be employed. Unless the purchaser's requirements are very specifically stated in the specification the tenderer should be given full information as to whether the gear is for ring main feeders, radial feeders, dead end sub-stations, &c.

For sub-station equipment the gear will normally be direct operated, but where separate control panels are required this should be clearly stated. If there is any question of space limitation, the specification should give the maximum area available or, preferably, a small plan of the station showing the space allocated for the gear. This is important in view of the fact that a certain type of gear which would otherwise be pre-eminently suited for that particular scheme may be debarred owing to space considerations, and another type have to be put forward. It may be remarked at this juncture that whilst every precaution is taken in the planning of new generating and transforming stations to obtain the best possible layout of boilers, turbo-alternators and transformers there appears to be a tendency to relegate the switchgear to any odd corner that happens to be left vacant. As a result, one gets frequent examples of an otherwise excellently planned station with totally inadequate space for the switching equipment. Inasmuch as the main switchgear is the nerve centre of the whole generating and distributing systems this is bad economy, and is not conducive to smooth and satisfactory working of the plant.

When dealing with switchgear for use abroad full particulars should be given as to the destination of gear. If, for diplomatic or other reasons the purchaser does not wish to disclose the exact destination, the altitude of the site and climatic conditions under which the gear will operate should be fully stated. For instance, apparatus which would function quite satisfactorily in the moderate climate of South Africa would be quite unsuitable for the moisture-laden tropical climate of the Congo basin, or the river jungles of South Burma. Moreover, due to the rarefaction of the atmosphere at high altitudes it is well known that the flash-over voltage in air diminishes considerably as the height above sea level increases. That this phenomenon cannot be ignored is shown by the fact that for an altitude of 6,000 ft. above sea level the correction factor is 0.8, *i.e.*, switchgear suitable for 11,000-volt service at 6,000 ft. would have to be suitable for 14,000-volt service at sea level.

Having now dealt with some of the salient points of switchgear specifications we can make a brief examination of the two main types of specification issued. Probably there is wide divergence of opinion among estimating engineers themselves as to which of the types is to be preferred. Those who work chiefly by rule of

thumb will prefer the detailed specification which sets out each item in order whilst the true technical engineer will prefer the brief outline which gives him ample scope for ingenuity and judgment.

Considering, in the first place, the full and detailed specification, this has at least the advantage of not being ambiguous. The type of gear and the required rupturing capacity are clearly defined and the number, range and size of instruments for each panel are scheduled. Provided the tenderers work to the specification all the offers should embody the same amount of gear, and should be strictly comparable. This, of course, means much greater ease in the comparison of tenders. The tenders submitted should be short and concise, lengthy descriptions and schedules of gear being unnecessary. Even in these cases though, it is impossible to omit all descriptive matter. Little features which are considered to be in advance of competitors' designs have to be pointed out, and technical data for the oil circuit breakers have to be given. This raises a very thorny problem as there is at present no satisfactory method of determining the actual rupturing capacity of a breaker. Many items, such as length and speed of break, head of oil, air cushion, thickness of tank, &c., all play their part, and even the specialists have not yet achieved unanimity as to the proper correlation of the various factors. It will be found, however, that for any given breaking capacity the technical data of the breakers put forward by the well-known British manufacturers are fairly comparable. Reverting to the question of the specification, it will be found that almost invariably there will be some little point where the tenderer cannot comply with the requirements, and this has to be pointed out and the deviation justified. On the whole, however, the tender can, with care, be limited to small dimensions.

The great objection to the detailed specification is its rigidity. Although the scheme may suit one manufacturer it is highly improbable that it will be as acceptable to them all. They are bound, however, by the definite wording of the specification, and have to comply with its requirements as best they can, probably to the detriment of the best interests of both themselves and the purchasers. In many cases this results in the submission of a main tender complying with the specification, and also of one or more alternatives embodying the gear which is considered preferable. Here ease of comparison is lost, and as the alternative has to be fully justified the tender inevitably becomes cumbersome.

Let us now consider the other type of inquiry. This gives the size and function of the gear, location thereof both electrical and mechanical, together with a few general notes. It is left to the manufacturer to decide on the type of gear, methods of protection, &c., from the data supplied. It is here that the estimating and sales engineer has an opportunity to justify his much maligned existence and prove his worth. A careful study of the conditions obtaining will enable him to decide on the best and most economical type of equipment, and it may then be necessary to discuss his propositions with the purchaser before submitting a formal tender. This preliminary co-operation between prospective purchaser and manufacturer will often prove to be the best means of eliminating waste in tendering. Failing this, it will be found necessary to submit several alternatives, and herein lies one of the drawbacks of this type of inquiry. Moreover, there will be wide variations in various tenders, and fine discrimination will be necessary in their analysis. The purchaser will be confident, however, that each manufacturer is putting forward his best type of gear unfettered by superfluous restrictions.

In conclusion, it may not be inappropriate to mention the arrangement of prices. It does not appear to be generally realised that the quoting of itemised prices throughout throws a lot of additional work on the tenderer. Moreover, the prices thus obtained are not always true. For instance, in the erection of a number of small switchboards all forming a part of one scheme it is impracticable to so divide the overhead supervision charges and travelling expenses that each panel bears its correct proportion, and an average has to be taken. A certain amount of sub-division of prices is welcomed by the manufacturers, but there is a tendency to carry it to lengths which are neither useful nor necessary.

The author hopes that the above notes may help switchgear purchasers to understand some of the difficulties of the estimating engineer, and perhaps lead to a nearer approach to that chimera, the ideal specification.

The Future of German Industry.

Speech at the A.E.G. Meeting.

As contrasted with the colourless statements made at the annual meetings in the past few years, the speech which was delivered by Dr. Deutsch at the meeting of the Allgemeine Elektricitäts Gesellschaft held in Berlin on January 22nd appears to be of particular interest, as it purports to indicate the lines of future industrial development in that country. Addressing the shareholders, Dr. Deutsch stated that the "economy" that had developed from the period of inflation was organised otherwise than in 1914. The formation of groups in a horizontal and vertical direction had made progress, although it was not yet clear whether this had led in all cases to increased productive efficiency, or only to the strengthening of undertakings which rested on a speculative basis. In the former case there would be shown as an important result a simplification of the production and organisation, while in the latter the influence built up on financial speculation would have to be altered according to the necessities of production.

The director proceeded to remark that the tendency to incorporate productive establishments under one management, with a uniform organisation, would certainly be carried out, but not on the Ford system, of which there had been a lot of discussion in Germany for some time past as a universal remedy. The admirers of that system should be quite clear as to the fundamental difference between the German and the American conditions of production and sale. The development of a standard type in the United States was based on the almost unlimited receptivity of the market and the similarity of its requirements. A country like America, which was approximately self-sufficient in its resources in raw materials and whose exports only formed a small percentage of its annual output, was able to build up its production and to determine its direction in quite another manner than industrial Germany, which was decidedly dependent upon the world market for the supply of raw materials and the sale of manufactures.

In this connection Dr. Deutsch pointed out that the success of German industry in the world market had been based not so much on the delivery of bulk products; the industry rather satisfied the individual taste—the individual wishes of the world market. Thus the Germans had developed industries which had necessitated the manufacture of a large number, perhaps an excessive number, of types. This had been profitable so long as the consumption in the German inland market had increased and the exports had expanded by a certain percentage year by year. Now Germany must concentrate more upon the inland market, as prohibitive duties

and the protectionist policy of many countries prevented an increase in the exports. During the war the old works in almost all countries had been extended and new works established, partly for the production of war material and partly to turn out those manufactures which were formerly purchased from other countries. There was no doubt that the industrial capacity of the world was considerably greater than before the war, and this, too, with a reduced purchasing capability, but the fact remained that the requirements of the world were extraordinarily large, although they could not immediately be satisfied owing to the lack of means. The adoption of the Ford system in Germany only seemed possible in the way of a horizontal structure in all essential industries. This did not mean the formation of syndicates or communities of interests, but solely that similar works should become welded into a community in which the varied interests were uniformly considered and all forces were managed in a uniform direction. A considerable reduction in the expenses would be brought about by the discontinuance of a number of constructional offices, patent offices, laboratories, and the very costly sales organisations and propaganda. Above all, however, through the combination in manufacturing and the carrying out of a uniform programme of production in the various works of the same industry, it would be possible so to reduce the general expenses that the sale prices would be lower, the sales higher, and the profits increased. The general expenses of present manufacturing and organisation in all countries would be too high in the long run. In Germany a standard type was only possible for definite articles of use, such as, for instance, automobiles, motor-cycles, sewing machines, glow lamps, small motors, &c. In the case of all other technical products, which were produced in equally good quality by financially strong and equal firms, the way, in the first place, was only in the direction of the production community, that is to say, the "horizontal" combination. Besides this first decisive step, the director saw as a necessity an industrial undertaking among the European countries, and further with the American States, in order to regulate the sales conditions in the world market. The industrial area of Central Europe, which had been cut through by the Franco-German frontier, must be joined together in order that a sound basis might be found for future economic development.

So far as the electrical industry was concerned, Dr. Deutsch said that the Germans could look hopefully to the future. They were only at the beginning of the electrification of the railways, and the prospects of large power stations in many countries would be very favourable as soon as capital for such undertakings was rendered available. The modernisation of the German works, which had been in abeyance during the past ten years, had been resumed, and presumably offered the basis for active employment of the works. In conclusion, the director expressed the opinion that the close relations of the company with the General Electric Co. of the United States would be of considerable advantage, as they had thereby not only secured an interchange of patents and experience, but had also had placed at their disposal the inventions devised in the large laboratories in Schenectady.

The Electrical Contractors' Association.

Annual Dinner.

ON January 20th the annual dinner of the Electrical Contractors' Association (Incorporated), the N.E.C.T.A., Ltd., and the National Federated Electrical Association was held at the New Prince's Restaurant, London. The President, Mr. Walter Riggs, occupied the chair, and amongst the numerous guests were Sir Benjamin Longbottom (chairman, B.E.A.M.A.), General A. C. Baylay, D.S.O. (Engineering and Allied Employers' Federation), Mr. P. V. Hunter (vice-chairman, N.R.E.I.C.), Mr. W. C. P. Tapper (Pres., I.M.E.A.), Mr. S. R. Lowcock (chairman, Association of Cons. Engrs.), Mr. J. Gledson (Pres., E.W.F.), Mr. R. A. Ure (Pres., E.C.A., Scotland), Mr. J. Snow Huddleston (chairman, C.M.A.), and many other representatives of kindred associations, the members and guests numbering about 130.

After the toast of "The King," Mr. P. V. HUNTER proposed "The Allied Associations and Honorary Officials," referring to the altruistic constitution of the Contractors' Association, and describing the three Associations as forming an ideal organisation for one branch of the industry, on the lines of the highest statesmanship. He paid a cordial tribute to the activities of the secretary, Mr. L. G. Tate—"an ideal chief of the executive." In responding to the toast, Mr. RIGGS expressed his agreement with the proposer, and said that the E.C.A. represented the interests of all electrical contractors; its membership had more than doubled since 1918. The "trading policy" of N.E.C.T.A. was the first of its kind, and now after two years they were reaping the benefit. The agreements that they had made with other associations were mutually beneficial, and all difficulties were amicably settled by standing committees. The members of the Association purchased 2½ million pounds' worth of goods annually. The N.F.E.A., a trade union, had to deal with the E.T.U., and many disputes were settled during the year by committees without becoming serious matters. With regard to the I.E.E. wiring regulations, the Association was opposed to local codes, and wanted one standard set of rules and only one, whether they were the best possible or not. The National Register of Contractors ought to be developed by the Registration Board—that was not the function of the Association. Already contractors who were not registered were being passed over in favour of those on the register. Turning to the agricultural industry, Mr. Riggs remarked that the situation had been entirely altered during the last few years. According to the policy of the Electricity Commissioners, of concentrating generation in large stations and erecting high-pressure mains everywhere, the rural districts were being opened up and offered a vast field for the activities of the electrical contractor. There were some 25 million acres under cultivation or pasturage, carrying 1¼ million horses, five million head of cattle, 15 million sheep and three million pigs, and there were 800,000 workers on the land. The power required on a farm for ordinary uses was 1 h.p. per 25 acres, hence 1 million h.p. was required. Agriculture must always go on, offering a permanent load all the year round, valuable to supply authorities, contractors, and manufacturers. Standardising the pressure and frequency would enable the manufacturers to cheapen the cost of production, and the apparatus would be universally applicable. The villages and small towns would also offer business to the contractor. Farmers to-day were not conservative; they knew what other nations were doing, and wanted similar facilities.

Mr. H. MARRYAT proposed "The Guests," referring to the valuable work of the I.E.E. for all sections of industry, to the harmony prevailing between supply authorities and contractors, and to the other branches of the industry represented there. In reply, Mr. LL. B. ATKINSON said that the close relationship between the I.E.E. and the contracting industry was of the greatest advantage to all concerned, and pointing out that under modern conditions electrical installations might be dangerous, he defended the new wiring regulations. The spirit of organisation and united policy which marked their Associations should pervade the whole industry. Gen. A. C. BAYLAY, also responding, emphasised the importance of developing the industries of the country, to provide employment.

Mr. J. W. RICKEARD, J.P., speaking as a farmer, referred to the introduction of the sugar-beet industry, and stated that electric power would play a great part in the future of agriculture. In Denmark the farmers had a cheap supply of electricity, and British farmers would welcome it in substitution for tractors and oil engines, to lessen the cost of production.

Mr. R. ROBSON proposed "The Electrical Development Association," pointing out that whilst it had done wonderfully well with the funds available, the industry ought to support it adequately. He suggested that contractors should contribute according to the size of their businesses; at present the Electrical Contractors' Association only gave £400, and the total annual income of E.D.A. was only £11,000. He criticised the salesmanship conferences, and suggested that E.D.A. should enter the schools, teaching the girls to use electricity in the home, and the boys to use electric power.

Mr. J. W. BEAUCHAMP responded, declaring that the contractors, whose status had risen amazingly in recent years, were too modest and did not advertise themselves sufficiently. New lamp connections were being made at the rate of 5,000 a day! He asked them to support the Women's Electrical Asso-

…ion, which would carry propaganda into the women's …ies, and urged that too much dependence was placed upon …entary help—they must pay for advertisement. "Get …ether, and step on the gas!"

Mr. H. T. YOUNG proposed the health of the Chairman, …elling on his exceptional abilities and incessant labours for …e Association; the toast received musical honours, and Mr. …son briefly responded.

…musical programme was rendered during the evening, and …function was very enjoyable.

Legal.

…itish Insulated & Helsby Cables, Ltd., Pension Fund.

…e Court of Appeal recently decided that a sum of £31,734, …tributed by the British Insulated & Helsby Cables, Ltd., …1916 as the nucleus of a pension fund for its employés, …ld not be allowed as an admissible deduction from profits …assessment to income tax, thus reversing the decision of …Justice Rowlatt in the King's Bench Division (*vide* ELEC. …r., July 4th, 1924, p. 44, and November 14th, 1924, p. 760). …e company, having lodged a formal notice of appeal to …e House of Lords, has requested the Association of Super…nuation and Pension Funds to secure for it financial …pport in meeting the expenses, estimated at £2,000.

…It is felt that the case vitally affects all employers who …ve made similar payments to superannuation funds, or who …e preparing to do so, and the council of the Association …s decided to ask all its members and other companies …o have funds in existence, or in contemplation, to join in …aranteeing a fund in aid of the proposed appeal. Sir John …non has been briefed by the company, and three guar…tees of £100 each have been reported to the committee.

Postmaster-General v. Dudley Corporation.

…e Dudley County Court, before Judge Tebbs, on January …d, the Postmaster-General asked for a decision in his …our regarding the placing of six telegraph poles on a public …adway, which was opposed by the Dudley Corporation. It …s stated that the cost of erecting them by the roadway …uld be only about £20, whereas the laying of underground …bles would involve an expenditure of £142.

His Honour decided in favour of the Postmaster-General but …t the questions of terms and costs to be settled by the two …rties.

Theft of Accumulators.

…e West London Police Court on Thursday, January 22nd, …fore Mr. Forbes Lankester, Percy Alfred Shackle, clerk, …est Ealing, and Reginald Lloyd Chapman, electrical engi…er, Fulham, were charged with being concerned together in …aling and receiving two 6-V batteries, valued at £6, belong…g to Messrs. C. A. Vandervell & Co., Ltd. Chapman was …o charged with stealing two accumulators from a garage. …th defendants pleaded guilty and were bound over to come …o for judgment if called upon, Chapman being placed on …obation.

British Thomson-Houston Litigation.

…e case of the British Thomson-Houston Co., Ltd., against …lpern came before Mr. Justice Astbury, in the Chancery …vision, on January 23rd, on an *ex parte* application by the …aintiffs for an injunction to restrain the defendants from in…nging letters patent usually called the "leading-in" patent. …His Lordship granted the injunction *ex parte* until January …th, and gave leave to serve motion for that day.

Radio Instruments, Ltd., v. Radio Improvements, Ltd.

…e the Chancery Division, on January 20th, before Mr. Justice …wrence, this part-heard action was mentioned.

Mr. HUNT, who explained that he was with Sir Duncan …erly, K.C., said the parties had arranged terms and all that …e Court would be asked for in the circumstances was an …der staying all further proceedings on the terms scheduled, …cept for the purpose of enforcing terms. There would be …erty to apply to the Court again. The defendants would …dertake to change their name and the plaintiffs also agreed …at they would not alter their name in a certain way.

Radio Experts, Ltd., v. H. G. Weiner & Co.

…e the Middlesbrough County Court, on January 19th, the …laintiffs sued H. G. Weiner & Co., of Leicester, for £80, the …alue of radio goods supplied. The defendants had filed an …ffidavit pleading for an adjournment, but Mr. Cecil Ridley, …anaging director of the plaintiff company, objected and …leaded for immediate judgment. The Judge examined the …ffidavit and the correspondence and decided that plaintiffs …ere entitled to judgment.

Correspondence.

Correspondents should forward their communications **at the earliest possible moment.** *No letter can be published unless we have the writer's name and address in our possession.*

The Illumination of Large External Areas.

I was interested to read Mr. Johnstone's description of the particular system to which he refers in your issue of 2nd inst. It would seem, however, that by the adoption of seven lenses and the corresponding number of mirrors, he realises the imperfection of the gasfilled lamp as a point source of light. Is it not obvious that if the whole point source were approached in a greater degree (as in the case of the arc crater) only one mirror would be necessary, and therefore, if this mirror were of parabolic or elliptical-parabolic section, lenses would not be required, if the source of light were placed at the focal point?

I am afraid Mr. Johnstone has failed to keep himself posted in the developments of searchlight projectors, when he states that "the main disadvantage being that such projectors are of the hand-feed type." I would suggest that he communicate with some manufacturers of this class of equipment, and he will, I have no doubt, be offered projectors as automatic in their operation as the standard street-lighting arc lamp.

The question of current consumption must necessarily be placed against the intensity on the working plane for a given area of illumination. The intensity on the working plane depends, primarily, on the intensity at the source of light. Now, will Mr. Johnstone explain how, given a current consumption and a given area to be illuminated, the efficiency of the installation is greater when using a light source having the intrinsic brilliancy of a gasfilled lamp, as compared with a light source having the intrinsic brilliancy of the arc crater? If Mr. Johnstone can satisfy himself on this point, I do not think the discussion need be carried further.

In conclusion, he refers to wind-pressure at a 10-ft. surface at an elevation of 100 feet. I think our crane designers have handled more serious problems than that.

Leslie G. Toplis.

Glasgow, *January 19th*, 1925.

Testing with Kenotrons.

I have read Mr. Nelson's letter of the 11th inst. with interest.

Unfortunately I have not the previous correspondence before me as I write. It appears to me, however, that the X-rays he has apparently detected are due to "saturation" of the kenotrons. In charging up a condenser system, large currents would tend to flow momentarily, particularly in the initial stages. The electron emission from the filament at the maximum temperature specified by the makers might not be sufficient to carry these current impulses, with the result that a potential would be built up across the valve, the cold electrode being positive.

This would reproduce exactly the conditions under which hot-cathode tubes are used in X-ray work, for example, the Coolidge X-ray tube.

In extreme cases, with, say, a very powerful transformer feeding a large capacity through hot-cathode valves capable of carrying comparatively small maximum currents, the potential across the valves in this direction might reach the full value of the h.p. transformer. The result would be a powerful emission of X-rays if the potential involved happened to be 30 kV or over.

I suggest that impedance could be introduced into the circuit to prevent the saturation current being reached, and I think this should be possible without detracting materially from the efficiency of the method.

If precautions are not taken either to avoid the productions of X-rays or to protect operators from them, we may see some of the unfortunate results which early workers with X-rays experienced, and I think Mr. Nelson is deserving of thanks for bringing the possibility to notice.

H. A. Quinton.

London, *January 16th*, 1925.

The Kearney Railway.

Our attention has been called to the remarks of your contributor in the current number of the ELECTRICAL REVIEW. In this he mentions what must be patent to all, *viz.*: that the use of gravity for accelerating and retarding trains is not new, but at the same time he shows that he has no clear or correct comprehension of Mr. Kearney's proposals or of the characteristics of the ordinary electric traction motor. Otherwise he could not have made the astounding statement (for the columns of an electric journal) that "as stations must always be on level track, no help is obtained from gravitation when it is most needed." Anyone who knows anything at all about the operation of electric railways knows that at the moment of starting the electric motor exercises its greatest torque with a minimum consumption of energy. It is only after about the tenth second from starting that energy consumption begins to be at all serious, and it is just at this time that gravity, under Mr. Kearney's system of gradients, comes in and does practically the whole of the work of

accelerating the train to its maximum speed. That your contributor could have made such a statement shows that he completely misunderstands the whole principle of gravity operation as laid down by Mr. Kearney, and accordingly he is in no position to criticise.

His remarks about the deputation to the Ministry of Transport are equally wide of the mark and written without correct knowledge of what occurred. It was never "alleged" that the Kearney Society represented five million people (actually the membership all told is under one thousand) but that the deputation contained delegates from local authorities having nearly five millions within their borders. The deputation did not merely consist of representatives from the Woolwich district as stated on page 107 of your same issue, but included delegates from two county councils, three county boroughs, twelve metropolitan borough councils, besides urban district councils, parish councils, chambers of commerce and other bodies.

These public bodies did not join the deputation without making the most careful inquiries into the Kearney system. The Kearney system has been examined and approved on all points and claims by a large number of engineers, many of whom are sufficiently eminent to remove all doubts. A partial list (47 names) is enclosed for your information. With regard to the point you raise of the impossibility of through running, the Parliamentary Secretary to the Ministry of Transport definitely stated that he did not regard it as being important.

A lot more could be said in explanation and amplification, but the above, we think, sufficiently covers the only serious points raised by your contributor. We feel sure you will extend to this letter the same degree of prominence as the original article.

Chas. F. Klapper,
Hon. Secretary.
The Kearney Society.

London, *January 23rd*, 1925.

[We fear our correspondent is somewhat out of his depth; or perhaps he is unduly influenced by "the whole principle of gravity operation" *as laid down by Mr. Kearney*. We may tell him what our readers do not need to be told—namely, that at the moment of starting, the d.c. traction motor is taking its full current from the line at full line voltage returning nothing at all; that is, its efficiency is zero, that moment, too, the frictional resistance is at its maxi The greatest waste of energy in the rheostats takes place ing the first ten seconds or so of the run—before gravity lend effective assistance.

The report of the visit of the deputation to the Mi of Transport (at which no representatives of the Press present) was issued by a Press agency which must have rived its information from some member of the deputa and important corrections were issued on the following at the instance of the Ministry. We do not regard details of the constitution of the deputation or the other points raised by Mr. Klapper as calling for comment, to point out that the remarks which he challenges were those of a "contributor."—EDS. ELEC. REV.]

Good Loud-Speaker Reproduction.

I was extremely glad to see the views expressed by Matthews in his letter in the ELECTRICAL REVIEW last w I should like to express my entire agreement with these vi and in order that you may appreciate how closely my opinions agree with those of Mr. Matthews, I enclose sh to which are attached in parallel columns (*a*) Excerpts f his letter (amounting to 68 per cent. of the whole), and excerpts from an article by myself which appeared in *perimental Wireless and the Wireless Engineer* for Janu published on the first of the month.

I think you will agree that the exact correspondence, only in ideas but actually in phraseology, is more than a li curious.

P. K. Turner.

London, *January 23rd*, 1925.

[The parallelism is so exact in the numerous paragra cited by the Editor of *Experimental Wireless* that only conclusion is possible. We very much regret that we h been inadvertently led into publishing so much of Turner's instructive article without due acknowledgment. EDS. ELEC. REV.]

Business Notes.

Bankruptcy Proceedings.—JAMES BONELLE, 131, High Street, Smethwick, Staffordshire, general merchant and manufacturer.—The public examination of this debtor was held on January 16th at the Law Courts, West Bromwich. The statement of affairs showed gross liabilities of £3,720, and there was a deficiency of £2,695. Debtor stated that in 1919 he entered into partnership with three others in a toolmaker's business at Blackheath, but subsequently he withdrew. In June, 1922, he started trading at Smethwick with £150 capital, £100 of which was borrowed from a relative and still owing. At first he dealt in hardware and cutlery, but subsequently he added a wholesale wireless branch. This was fairly successful at the outset, but later losses were incurred through bad debts and thefts. In July last debtor executed a deed of assignment. Debtor was ordered to furnish further details with regard to goods alleged to have been stolen and to law costs, and the examination was adjourned.

J. B. SHIELDS, Linthorpe Road, Middlesbrough, Yorks., master plumber and electrician.—The public examination of this debtor was held recently at the Court House, Middlesbrough. The liabilities were estimated at £1,214, against assets of £474, leaving a deficiency of £740. Debtor stated that he commenced business on his own account after the war, his only capital being £28, his Army gratuity. He had a shop in Newport Road, but later removed to more commodious premises in Linthorpe Road, and entered into contracts for a considerable sum. Debtor thought he had sufficient capital to carry out the contracts, but trade fell off badly. The goods had been sold, but had not brought what he expected. Debtor became aware of his position three months ago, but carried on business in the hope that an improvement would enable him to pay his creditors. The examination was adjourned.

J. E. BYRNE, 3, Wells Yard, Hull, electrical contractor.—The receiving order in this matter was made on debtor's own petition. The statement of affairs showed liabilities of £184, against assets of £70. The first meeting of the creditors was held recently at the Official Receiver's Office, Hull. The following are creditors:—

	£		£
Beadle & Co., Ltd.	87	Gilbert & Co.	10
General Electric Co., Ltd. ...	12	Bankers	47

L. BACKHOUSE, C. H. THORNTON and S. EVANS (Arc Electrical Co.), electrical and wireless supplies, Palatine Buildings, Victoria Street, Manchester.—Last day for proofs for dividend, February 6th. Trustee, Mr. A. T. Eaves, 15, Fountain Street, Manchester.

C. PEACOCK, electrical engineer, 51, Gillygate, York.—Last day for proofs for dividend, February 7th. Trustee, Mr. D. L. Mackay, Duncombe Place, York.

JOHN KINGSTON, 176, Romsey Road, Shirley, Southampto trading as the Cromwell Engineering Works, electrical a general engineers.—The public examination of this debt was held on January 21st, at the Court House, Southampto The statement of affairs showed a surplus of £82. Debt said that he purchased the business for £250, but it h never yielded sufficient for him to make a living. Aft further questions concerning recent small debts, the examin tion was closed.

ARTHUR MEADOWS, electrician, The Arcade, Penzance.—Th public examination of this debtor was held at Truro Ban ruptcy Court on January 19th. His deficiency was put £253. He attributed his failure to insufficient capital, ke competition, and the income from the business being too sm to meet business and personal expenses. The examinatio was closed.

R. HAMMOND, electrical engineer, 3, The Arcade, Geor Street, Richmond.—Last day for proofs for dividend, Februar 7th. Trustee, Mr. E. H. Hawkins, 4, Charterhouse Squa E.C.

H. P. GALT, electrical engineer, 56, Norbury Road, Thornto Heath.—Application for discharge to be heard March 9th the County Court, Croydon.

Company Liquidations.—BOVING ENGINEERING CO., LTD. Fenton, near Stoke-on-Trent.—A meeting of the creditor herein was held on January 19th, when the chair was take by Mr. D. M. Touche, the liquidator appointed in the volun tary liquidation proceedings recently resolved upon by th shareholders. The chairman said that he had been appointe receiver on behalf of the debenture holders, who were th Midland Bank's nominees. He had also been invited to ac as the liquidator of the company, and his acceptance of thi invitation had been more or less a matter of duty than any thing else, as it had been apparent from the very first tha the prospect of anything remaining for the unsecured creditor after the debenture holders had been satisfied was a ver uncertain one. The indebtedness to the Midland Bank with interest amounted to £25,630, while the unsecured creditors claims amounted to £9,462, which gave a total of £35,09 With regard to the assets, there was at present a sum o £11,532 to the credit of the receiver's account at the bank, and a few more thousands of pounds were yet to com in. Freehold land and buildings at Stoke-on-Trent were put down as being of the book value of £18,180, and the plan and machinery £20,330. The works were being put up fo auction on February 6th next, and he had endeavoured t interest likely parties in these works with a view to thei disposal as a going concern, but so far these efforts had bee made without success. He had already sold the goodwill,

patterns and drawings for £3,000. Sir Wm. G. Armstrong, Whitworth & Co., Ltd., had agreed to take over the pump testing station on a fair valuation, and the Stoke Corporation had agreed to purchase the sub-station for £350. It was for the creditors to determine whether they wished to apply to be Court for the appointment of another liquidator or for another liquidator to be appointed conjointly with himself. With regard to the debentures, these had been issued to the nominees of the Midland Bank on July 30th, 1919, the debentures being issued by way of security for the bank overdraft.

Questioned by creditors, the Chairman said that for the three months ended September 24th last the company made a loss on its trading of £2,361. For the six months ended June 30th, 1924, the loss of the company amounted to £6,188. The chairman said that the property consisted of about four acres of land, and well-constructed buildings suitable for the purposes of the business had been erected, and there was a railway siding which was one of the best points about the property. The company carried on a general engineering business, and in normal times had done a return of about £60,000 to £70,000 per annum. The concern had suffered very much from the prevailing depression in the engineering trade. The company was incorporated in 1918, the share capital being £60,602 divided into preference and ordinary shares. One creditor asked whether the £25,000 lent by the bank had been traced in the company's books, and the Chairman replied in the affirmative, saying that this money had been provided in cash. No resolution was proposed, and the meeting expressed its satisfaction with the present liquidator's retaining his position. The following are creditors:—

	£		£
C. P. Colpitts	206	Dunkerley & Co.	157
Climax Roche Drill & Engineering Co.	27	Dorman, Long & Co., Ltd. ...	59
Carriers Publishing Co. ...	20	Gandy Belt Mfg. Co.	98
Colliery Guardian	24	Hill & Ainsworth	49
Colliery Engineering	77	J. & A. Hillman, Ltd.	71
Engineer, Ltd.	71	Jessop & Sons	142
Engineering, Ltd.	36	Keith & Blackman Co.	67
Foundry Trade Journal	25	Meilard & Sons	155
Iron and Coal Trades Review ...	153	Marsden & Sons	118
R. Millet	44	Metropolitan-Vickers Electrical Co., Ltd.	371
New Marine Engineering, Ltd.	98	Midland Coal & Coke Co. ...	92
Bagshaw & Co.	29	Pidduck & Beardmore	297
Billington & Newton	305	Redpath, Brown & Co.	76
British Thomson-Houston Co., Ltd.	50	Stoke Corporation	1,002
Campbell File Co.	38	Settle, Speakman & Co.	171
Consolidated Pneumatic Tool Co., Ltd.	37	South Durham Steel Co. ...	386
Dunlop & Rankey	71	White & Taylor	159
Hoffman Mfg Co., Ltd. ...	60	P. & W. Ward, Ltd.	159
H. Pollard & Co.	173	Youngs, Ltd.	48
Ruggles Coles Engineering Co.	24	Monks, Hall & Co.	50
Sandycroft, Ltd.	26	Halesowen Steel Co.	21
Atlas Steel Foundry & Engineering Co.	417	Skinner & Co.	66
Asbestos Paint Co.	40	Sterling Foundry Specialities	38
Brayshaw, Ltd.	67	Spencer Bonecourt, Ltd.	35
Barnell & Sons	29	Sturtevant Eng. Co., Ltd. ...	36
British Oxygen Co.	71	S. Platt, Ltd.	31
Braby & Co.	31	R. & A. Naylor, Ltd.	45
N. J. Barr	80	Norton & Gregory	26
Brush Electrical Eng. Co., Ltd.	200	Marsden & Sons	118
Bolckow, Vaughan & Co. ...	78	H. Morris, Ltd.	30
Cammell, Laird & Co., Ltd. ...	222	J. & A. Hillman	72
		G. & J. Holt	34
		Hall Line	29

It was announced last week that Sir W. G. Armstrong, Whitworth & Co., Ltd., had acquired from the Receiver the whole of the goodwill, patterns, &c., of the Boving pump, and would undertake the sole manufacture of this appliance.

CODD ARC LAMP CO., LTD.—Winding up voluntarily for reconstruction purposes. All creditors will be paid in full. Liquidator, Mr. F. Taylor, of Knitters & Weavers, Ltd., Longden Street, Nottingham. A meeting of creditors was called for January 28th, at the registered office of the company, Dame Agnes Street, Nottingham. Particulars of claims to be sent to the Liquidator forthwith.

STELLA CONDUIT CO., LTD.—A notice appeared in our issue of January 16th regarding the winding up of "*The* Stella Conduit Co., Ltd.," which was sold in August, 1923, to the present company, trading as "Stella Conduit Co., Ltd." We are asked to state that the new company has no connection whatever with the old company financially, and that the management is entirely new.

THE NORTHERN RADIO CO., LTD., 19, Hopwood Avenue, Market Place, Manchester.—The adjourned meeting of the creditors of this company was held recently, when the creditors decided to confirm the voluntary liquidation of the company, with the liquidators nominated by the shareholders, Mr. W. A. Appleton and Mr. W. L. Sibley. At the previous meeting it was stated that the unsecured liabilities amounted to £6,682, while the assets were estimated to produce £2,559.

Private Arrangements.—JAMES HILL & SONS, Bury, electricians, &c.—A meeting of the creditors of the above was held recently, when a statement of affairs was presented which showed liabilities of £8,174, of which £4,218 was due to the trade and £1,739 to cash creditors. The trustees of W. Hill, deceased, were partly secured creditors for £3,290, and they held securities valued at £1,250, and the bank was also a partly-secured creditor for £578, holding security valued at £491. The assets totalled £5,398, a deficiency of £2,776. The solicitor explained that as a large number of writs had been issued and several creditors were in a position to levy execution; the debtor had executed a deed of assignment in favour of Mr. J. Moore, accountant, of Bury. The present position was attributed partly to payments to a partner who withdrew from the business in 1914, which reduced the working capital, and to trade depression. A balance-sheet as at September 30th, 1923, was available, and that showed stock at £3,542. The turnover for the previous twelve months had been £9,670, and the net result of the trading was a loss of £1,000. The drawings for the period were £485, and since then the debtor had drawn £6 per week. The matter was discussed at considerable length, and it was eventually resolved to confirm the deed of assignment already executed to Mr. Moore, and a committee of four of the creditors was also appointed. It was stated that there were reasonable prospects of friends of the debtor coming forward to purchase the business as a going concern.

EGMONT GORDON HAKE and WILLIAM COATS LINDSEY, trading as the Holmeside Wireless Co., 34, Vine Place, Sunderland.—A meeting of the creditors interested herein was held on January 16th, when a statement of affairs was presented which disclosed liabilities of £1,209. Of that amount £1,201 was due to unsecured creditors, while there were partly-secured creditors for £16, who held security valued at £8, leaving £8 to rank as unsecured. The assets amounted to £550 4s. 6d., from which had to be deducted £45 for preferential claims, leaving net assets of £505, or a deficiency of £704. It was reported that the debtors started business in February last, but owing to lack of capital and heavy overhead expenses it was impossible to carry on. They were not very successful at first, but during the last three months their takings had increased. The creditors decided that a deed of assignment should be executed in favour of Mr. Robert Chapman as trustee, with a committee of inspection consisting of Mr. A. Albrecht (North British Engineering Equipment Co.), Mr. J. K. Green (Sun Electrical Co.), and Mr. W. Curtis (General Electric Co., Ltd.).

LEOPOLD BRILLIANT, trading as L. Brilliant, and the Brilliant Wireless Co., 329, High Holborn, and at Marine Arcade, Great Yarmouth, and Marine Drive, Margate, as C. May and Co., dealer in radio goods, &c.—The creditors interested herein were called together recently, at the offices of Messrs. Westacott, Quaife & Co., Fenchurch Street, E.C., when a statement of affairs was submitted which disclosed liabilities of £3,178, all due to unsecured creditors. There were fully-secured creditors for £196, who held securities valued at £241, leaving a surplus of £45. The assets totalled £444, from which had to be deducted £400 for preferential claims, leaving net assets of £44, or a deficiency of £3,134. It was reported that the debtor had been in business for many years at various addresses in London, and some years ago he started at Yarmouth and Margate. The last two businesses were seasonal, and were at the present time closed. It was stated that the books were not up to date, and the figures given in the statement of affairs were approximate. The debtor's father was included as an unsecured creditor for £400 in respect of the balance of money lent some years ago for the purpose of the payment of a composition to the creditors at the time. It was eventually decided that, conditional upon the father retiring his claim of £400 in the event of the matter being dealt with privately, the deed of assignment already executed to Mr. A. E. Quaife, as trustee, should be confirmed, while a committee of inspection was also appointed consisting of Messrs. Darag (London), Ltd., B. Pims & Co., Robins, Brilliant & Co., Zeitlin & Sons, and Mr. G. Bowerman.

Copper and Lead Prices.—Messrs. F. Smith & Co. report January 27th:—Copper (electrolytic) bars, £71 10s., 5s. increase; do. do. sheets, no change; do. do. wire rods, no change; do. do. h.c. wire, 10 1-16d., 1-16d. decrease.

Messrs. James & Shakespeare report January 27th:—Copper bars (best selected), sheet and rod, £96, £1 decrease; English pig lead, £41 5s., 35s. decrease.

Trade Announcements.—As from February 1st Messrs. FRANK KENT & Co. are taking over the business of the Burke Electrical Manufacturing Co., Ltd., and altering the style of the firm to John Godden & Co. The offices are to be transferred from Regent Street to 6, Francis Street, Victoria Street, S.W.1. (Telephone No.: Victoria 8370.)

Messrs. AUTOVEYORS, LTD., are establishing branches in New York, Paris, Berlin, and Amsterdam for the sale of British radio products in various countries, and the organisation is to be extended to other parts.

AUTOMATIC & ELECTRIC FURNACES, LTD., has opened a hardening department at its Farringdon Road premises for the heat treatment of tools, cutlery, springs, shafts, &c., for manufacturers.

The PEACEHAVEN ELECTRIC LIGHT & POWER CO., LTD., has recently established a radio department at its showrooms at Peacehaven.

Messrs. ELLIS & SONS (1923), LTD., of 6, Panyer Alley, Paternoster Row, London, E.C.4, have taken over the business of Messrs. G. Gilliver & Co., Ltd., of Kingsbury, and both companies will be under their sole control and management.

With reference to the announcement (ELEC. REV., January 16th, 1925, p. 94) of the dissolution of partnership of Messrs. W. E. Collins, A.M. & E. Coates (Albion Electric Stores, 9, New Station Street, Leeds), we are asked to state that the business will be carried on in the same name by Mr. W. E. Collins, who has taken over the assets and will attend to all debts due to and owing by the late firm.

SUPERLAMP, LTD., has secured premises at 92-94, Paul Street, E.C.2, and the offices have been transferred to this

address. The new telephone numbers are: London Wall 7869 and 7870. The company's branches at 197, Old Street, 7, Denmark Street, and 257, Hammersmith Road will continue as hitherto.

The electrical department of the business of MESSRS. HENRY S. TETT & CO., LTD., of Faversham, has been transferred from Market Street to the firm's works at The Mall.

The address of MESSRS. ASHFORD, DUNN & CO., is now Ryde Avenue, Hull.

Catalogues and Lists.—MESSRS. KELVIN, BOTTOMLEY AND BAIRD, LTD., 18, Cambridge Street, Glasgow.—An illustrated leaflet describing the "K.B.B." smoke and fume warning indicator.

MESSRS. SIEMENS BROS. & CO., LTD., Caxton House, Westminster, S.W.1.—Leaflet 2,036, describing the "Siemens" cable temperature indicator.

THE ENGLISH ELECTRIC CO., LTD., Queen's House, Kingsway, W.C.2.—Publication No. 225, containing illustrated and detailed particulars of the construction of the company's steam turbines.

MESSRS. PETTERS, LTD., Yeovil.—Publication No. 917, illustrating and describing "Petter-Light" small generating sets.

THE STERLING TELEPHONE & ELECTRIC CO., LTD., 210-212, Tottenham Court Road, W.1.—Publication 408, describing the "Sterling" crystal receiving set.

POPE'S ELECTRIC LAMP CO., LTD., 5, Arthur Street, New Oxford Street, W.C.2.—An illustrated catalogue of vacuum and gasfilled lamps of all kinds. Priced.

MESSRS. L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, W.C.2.—An illustrated pamphlet dealing with the "Universal" brushless vacuum cleaner, with an offer of a free trial.

THE HARROD MANUFACTURING CO., 375, Queen's Road, S.E.14.—A pamphlet describing a signalling rear lamp for motor vehicles.

MESSRS. H. C. TOFIELD, LTD., 30, Church Street, Birmingham.—An illustrated and priced folder advertising the firm's crystal and valve radio receiving sets and accessories.

MESSRS. BRUCE PEEBLES & CO., LTD., Edinburgh.—Pamphlet No. 21E, illustrating and describing "Peebles" d.c. motors and dynamos of medium sizes. Both English and metric dimensions and weights are given.

THE SYMPLEX MANUFACTURING CO., 45, Harrow Road, Brislington, Bristol.—A mailing card advertising the "Marshall" constant-potential battery charging system.

THE BRITISH L. M. ERICSSON MANUFACTURING CO., LTD., 67-73, Kingsway, W.C.2.—A coloured showcard advertising the company's radio apparatus.

ENGINEERING SUPPLIES, LTD., 235a, Blackfriars Road, S.E.1.—A wholesale price list of instrument and resistance wires, flexible and v.i.r. cables, sleeving, square connecting wire, &c.

THE CHLORIDE ELECTRICAL STORAGE CO., LTD., Clifton Junction, near Manchester.—A pamphlet illustrating examples of "Chloride" battery plates after many years of use.

Book Notices.—"Powell's Electric Supply Share Handbook," by H. H. C. Blake. London: Effingham Wilson. 5s. net.—This is a new edition in which the compiler has aimed at bringing up to date the information given in the first issue relating to electricity supply development. The main part of the book is devoted to a number of separate sections giving detailed financial and general information regarding forty companies in London and other parts of Great Britain which are engaged in the business of electricity supply. The information includes particulars of capital, profits, costs, dividends, output, purchasing powers, names of directors, &c., the secretaries of the various concerns having given assistance to ensure accuracy.

"Annual Report of the Director of the Bureau of Standards for the Fiscal Year ended June 30th, 1924." Washington: Government Printing Office.—This contains brief particulars of the numerous researches which were conducted during the year. These are classified under 11 heads which include electricity, heat and power, optics, metallurgy, mechanics and sound, &c.

"Catalogue de Photographies Documentaires." Pp. 258. Paris: Jacques Boyer.

"A.B.C. of Wireless," by P. W. Harris. Pp. 105, illustrated. London: Wireless Press, Ltd. Price 1s. 6d. net.

"The Practical Electrician's Pocket Book, 1925." (Pp. xci + 578 and diary.) London: S. Rentell & Co., Ltd. Price 3s. net.—A number of the matters contained in this, the 27th, issue of the pocket book have been revised in the light of the new I.E.E. wiring regulations, which, it may be said, have not been regarded by all the annuals. The sections dealing with measuring instruments, railway signalling apparatus, wiring systems, and radio work, have been re-written or revised. The article on special switches for house-lighting, &c., has been expanded, and one on time switches has been added. The usual central station tables, which are a valuable feature of the work, have been brought up to date and improved in some respects.

"Annual Report of the Smithsonian Institution for the year ended June 30th, 1922." Washington: Government Printing Office.

"Radio, Beam and Broadcast: Its Story and Patents," by A. H. Morse. Pp. 14+192, illustrated. London: Ernest Benn, Ltd. Price 12s. 6d. net.

"The Law Relating to Public Service Undertakings," by F. N. Keen. Pp. xii+320. London: P. S. King & Son. Price 15s. net.

"*Journal* of the American Institute of Electrical Engineers." Vol. XLIV. No. 1. January, 1925. New York: The Institute. Price $1.

The *Journal of Scientific Instruments*, produced by the Institute of Physics with the co-operation of the National Physical Laboratory, and hitherto published by the Institute, will in future be published by the Cambridge University Press on behalf of the Institute.

Calendars.—The 1925 calendar of ENGINEERING SUPPLIES, LTD., is of the "at-a-glance" type, *i.e.*, a celluloid strip with a little square cursor marks the day on a monthly slip.

We have received from the SOCIETA ANONIMA, "Ansaldo," Genoa, a set of calendar cards for 1925, each of which bears an illustration of one of the firm's products and information in Italian.

Dockyard Workers' Wages.—On January 24th, the Industrial Court published an award refusing an increase of 6s. 6d. per week in the wages of electrical fitters, boilermakers, and other tradesmen employed in H.M. Dockyards and Admiralty Establishments.

New French Company.—The Union Financière pour l'Industrie Electrique has been formed at Paris (73, Boulevard Haussmann), with the object of financially supporting companies concerned with electricity in any form. The capital is 13 million francs.

A View of German Electrical Competition.—The Manchester *Daily Dispatch* quotes "a well-informed English correspondent living in Berlin" as stating that Britain has little to fear from German competition in the electrotechnical industry. He says: "Germany has enough to do to equip her own market"! With regard to export trade, "the German electrical product is still far too dear to displace the foreign competitor." "Later on . . . Germany may again become a heavy exporter in the electrotechnical industry, but not for the present."

Advertising.—In an address on "The Romance of Advertising" at St. Annes-on-Sea, on January 23rd, Mr. A. Davies, passenger superintendent of the L.M.S. Railway, described advertising, backed by truthful description, as a great propelling force in commerce. Advertising must be progressive, starting with the general idea, and then specialising. It should also be continuous. By increasing sales it increased production, and consequently must be good for trade. Advertising cheapened commodities by bulk production. It created markets by bringing commodities to the people.

An Electrical "Sale."—The Bradford Corporation Electricity Department, at its fine showrooms in Sunbridge Road, commenced a special winter sale on January 19th, which remains open until the 31st, of electrical fittings of various kinds, fires, domestic appliances, and silk and glass shades. The window displays in connection with the sale have been particularly attractive, both in their arrangement and in the prices at which goods have been offered.

British Contracts in the Sudan.—Following the recent announcement that a group of four English firms has been entrusted with extensive engineering contracts at Khartum, including the building of a steel bridge over the White Nile and the electrification of the tramway service, it is of interest to learn that an order has just been placed for a complete system of coal-handling and storage plant to be installed at Port Sudan. It will consist of four of the largest bridge transporters constructed on the Temperley system, each over 400 ft. long, and arranged with a slewing motion to cover a very large area of the storage ground. The machines will be electrically operated, and will be fitted with grabs, each having a capacity of two tons. This plant will be built by Sir William Arrol & Co., Ltd.

German Competition in India.—An electrical correspondent, writing from India at the beginning of this month, states that business there is, generally, improving, but "the place is being invaded wholesale by Germans out to undercut English houses." He adds that the native buys in the lowest market he can find—hence the struggle is keen. "The India Stores Department also buys, regardless of quality, the cheapest it can get." The writer says that there is very little interest shown in wireless, "mostly because of poor programmes."

Local Exhibitions.—HALIFAX.—The Corporation Electricity Department has an attractive stand at an "Ideal Homes Exhibition" which was opened at Halifax Drill Hall on January 21st and closes to-morrow. The stand is devoted chiefly to labour-saving and other domestic appliances.

DOUGLAS (I.O.M.).—The Corporation Electricity Department is holding an exhibition with the object of inducing residents to install electric cookers in place of their coal or gas cookers. The Corporation is endeavouring to persuade residents to install electricity before the holiday season starts. The exhibition includes all kinds of labour-saving devices, and daily demonstrations of electric cookers, &c., are given.

For Sale.—Messrs. Cavey & Co. will sell by auction on February 11th, at 241, Clapham Road, S.W., 500 lots of new electrical and wireless material. Exeter Corporation Electricity Department invites offers for one 400-kW Bellis-Westinghouse steam alternator with condenser, pumps, &c. (See our advertisement pages to-day.)

Conditions in the Engineering Industry.—The summary of reports upon the conditions in the engineering industry during December, published in the January *Ministry of Labour Gazette*, indicates that, although employment was still bad, generally, there was a sustained upward tendency. In the electrical section the situation was good. The detailed statistics reflect the situation, there being a net decrease of 0.5 per cent. in the number of unemployed in the electrical engineering industries. Other decreases occurred in the electrical cable, wire and lamp industries (0.2 per cent.); the gas, water and electricity supply industries (0.2 per cent.); and the tramway and omnibus services (0.3 per cent.). On the other hand, there was an increase of 0.2 per cent. in the number of unemployed in the electrical wiring and contracting industry.

Wages in the Electricity Supply Industry.—District Council (No. 2) Yorkshire, &c., reports that its decision as to the revision of wages has been confirmed by the National Council for the Electricity Supply Industry. The result is that, in addition to 1½d. given in July last, there will be an increase of ½d. under the sliding scale agreement as from January 1st, and a further increase of ½d. per hour on the first pay-day in January. The question of a further ½d. increase under the sliding scale agreement has been referred to a special committee of the Council. The Council has also decided that the rates for blacksmiths shall be the same as those for mechanical and electrical fitters, and that the rates for blacksmiths' strikers shall be 1d. per hour above those for indoor labourers.

The District Council for the Electricity Supply Industry No. 5 (West-Midlands area) has decided that its resolution of December 20th, restoring the 2s. 6d. per week deducted from the wages of adult employés, agreed to in January, 1923, should be extended to include the restoration to the junior employés, under 21 years of age, of the 1s. 3d. per week deducted from their wages in February, 1923.

An agreement has been reached between the employers and the National Union of General and Municipal Workers in respect of the rates of pay of electricians in Devon and Cornwall. That area has agreed to give ½d. per hour increase on the basic rate, to take effect from December 19th last.

Railway Rates Decision.—On January 19th, the Court of Appeal dismissed the appeal of the railway companies from a decision of the Railway Rates Tribunal. The issue was related to the basis upon which the standard net revenue is to be estimated under the Railways Act, 1921, the companies maintaining that the income from certain investments should be taken into consideration. The decision of the Court of Appeal will affect favourably, in the form of lower rates, the whole of the trading community, and through them the general public, when the rates are eventually fixed by the Tribunal.

Goods Map for Traders.—For the assistance of manufacturers and traders throughout the British Isles, the London, Midland, and Scottish Railway has issued as a booklet a classified list of its goods stations in 2,592 towns, together with a large key map, 3 ft. by 2 ft., showing their positions on the system. In addition, information is given regarding bonded stores, warehousing accommodation, &c., with an offer of help in the finding of factory sites adjoining railway lines suitable for any manufacturing purpose.

South African Electrical Imports.—The *Board of Trade Journal* states that the imports of electrical material into South Africa during the first half of 1924 were valued at £60,000 more than in the first six months of 1923.

Czecho-Slovakian Tariff Reduction.—The *Board of Trade Journal* of January 22nd reproduces a translation of an additional commercial arrangement between Czecho-Slovakia and France, the terms of which are applicable to United Kingdom products. Reductions are made in tariffs on a number of articles, including electric lighting and starting accessories, electric hooters, &c., for automobiles, the tariff on which is subject to a reduction of 50 per cent.

New Zealand's Electrical Imports.—The British Trade Commissioner at Wellington states that during the quarter ended September 30th last electrical machinery and equipment was imported to the extent of £190,000 in excess of the value of imports in the third quarter of 1923. The share of the United Kingdom in this trade increased from 66⅔ to 71⅓ per cent.

British Indian Customs Tariffs.—Revised tariff valuations recently put into force by the Government of India are reproduced in the *Board of Trade Journal* of January 22nd. The import list imposes the *ad valorem* duties shown in parentheses upon the following items:—Electrical control gear and transmission gear, including switches, fuses, and circuit breakers rated at less than 10A for pressures not exceeding 250V, motor controllers, bare and insulated wires and cables, any core of which has a cross section of less than 1/80th of a sq. in., line insulators, cleats, &c. (15 per cent.); telegraphic instruments and apparatus for railways (10 per cent.); boilers, prime movers n.e.s., machines to be worked by power, and bare h.d. electrolytic copper wires and cables, poles, troughs, conduits, and insulators (2½ per cent.); and tramway track material (10 per cent.).

Lead.—Messrs. James Forster & Co. report under date January 24th:—"The continued fall in the price of lead this week is due to the action of consumers, who, in view of the previous week's fall, have been holding off the market. . . . Consumers, however, are none too well covered and it remains to be seen how long they can defer buying. Supplies meanwhile are well up to the average."

French Electrical Imports.—The imports of electrical machinery, apparatus, and allied goods into France during the nine months ended with September last attained a value of 136,514,000 fr. as compared with 98,795,000 fr. in the corresponding period of 1923. There was, however, a larger increase in the exports of similar material of French manufacture, the shipments advancing from 197,139,000 to 293,095,000 fr.

Irish Free State Electrical Imports.—The imports of electrical machinery, apparatus and accessories into the Irish Free State during November last attained a value of £47,126 as compared with £61,184 in the preceding month—bringing the total for the first eleven months of the year to £450,552. The appended table shows the details of the imports and the amount attributed to Great Britain and Northern Ireland, but it does not follow that they are all of British manufacture. Of the balance of £40,211 from foreign countries, £14,176 is attributed to Germany, £5,671 to Belgium, £12,762 to Switzerland and £7,602 to "Other Countries."

	Nov. 1924.	Eleven Months, 1924. Total.	U.K. Share.
	£	£	£
Electric wires and cables...	9,232	75,012	59,835
Telegraph and telephone instruments	2,035	27,318	27,193
Electric lamps and parts ...	2,881	22,558	21,076
Batteries and accumulators	4,665	26,137	24,268
Electric lighting accessories and fittings	6,918	33,659	32,624
Radio sets and apparatus...	3,675	88,058	85,777
Other electrical goods and apparatus	6,028	91,961	88,278
Electric generators ...	3,338	11,210	11,072
Electric motors	1,321	15,490	14,850
Other electrical machinery	7,033	59,149	45,368
Totals ...	£47,126	£450,552	£410,341

Industrial Welfare.—Evidence regarding the industrial welfare movement was given before the Committee on Industry and Trade on January 21st by the Rev. R. R. Hyde, Director of the Industrial Welfare Society, Sir William Waterlow, Mr. Ivon Braby, and others. The statement submitted by them is reported as follows:—(1) That industrial welfare work is increasing both in volume and scope, and is regarded by progressive employers as an integral part of management.

(2) That it has a beneficial effect both directly and indirectly upon productive capacity and efficiency.

(3) That although its value cannot be measured in terms of cash, it results in improved relationships, effectiveness, health, and interest.

(4) That its further development upon a voluntary and mutual basis would undoubtedly benefit British industry.

The Madrid Wireless Exhibition.—We have received from Marconi's Wireless Telegraph Co., Ltd., photographs, one of which is reproduced herewith, of the stand of its associate,

Marconi Apparatus at the Madrid Exhibition.

the Cia. Nacional de Telegrafia sin Hilos, at the recent Madrid Wireless Exhibition. This display, as will be judged from the illustration, was representative of many branches of the radio art.

The Lyons Fair.—In reminding us that the Lyons Fair is being held from March 2nd to 15th, Mr. J. A. Victor, 77a, Queen Victoria Street, E.C.4, the official British representative, informs us that special conducted tours are being arranged for the benefit of British visitors, in conjunction with Messrs. Thos. Cook & Son.

The German Aluminium Market.—It is stated that at the beginning of this year business in crude aluminium became very active, the consuming branches having placed orders for large parcels. The determining cause is probably to be found in the reports received from abroad that foreign works had sold their output for some time forward and that no stocks existed at the works. The new aluminium producing works on the Inn was set in operation this month and the output is said also to be sold forward.

The Floodlighting of the Belfast City Hall.—Mr. Johnstone Wright, M.I.E.E., the engineer and general manager of the Belfast electricity undertaking, has sent us a photograph of the City Hall as it now appears at night. The photograph,

The Belfast City Hall.

which is reproduced herewith, illustrates a good example of floodlighting such as has become very popular in connection with public buildings in the United States. In the lighting of this fine building Mr. Wright employed eighteen 500-W projectors of the British Thomson-Houston Co.'s manufacture.

Fire.—A fire in the power house of Messrs. Cochrane and Co.'s ironworks, Middlesbrough, on January 23rd, practically destroyed the building and severely damaged the machinery.

E.D.A. Activities.—The most recent pamphlet issued by the British Electrical Development Association (E.D.A. 524) sets forth the procedure necessary to obtain a supply of electricity and the method of employing it when it has been obtained. The advantages of electric lighting, heating and cooking are briefly but effectively stated and the publication should arouse interest in those to whom it comes.

An Osram Dinner.—The annual dinner of the staff of the Osram-G.E.C. Lamp Works and the M.O. Valve Works, was held at the Café Royal on Saturday last, the occasion being marked by a record attendance.

After the Chairman (Mr. C. WILSON) had proposed the loyal toast, "The G.E.C." was toasted by Capt. HIGGINS, who said that the best efforts of a staff were hampered if the financial arrangements were bad. The organisation was particularly blessed in this respect.

Mr. HUGO HIRST, in rising to respond to the toast, mentioned that telegrams expressing their regret at being unable to attend had been received from Dr. Railing, Mr. Max Railing and Sir William Noble. He said that money was easily obtained when the staff worked as well as the G.E.C. staff. The General Electric Co. was more than a mere money-making concern, and more than a business or engineering organisation, it was something very much bigger than either. It contributed an enormous amount in taxation and wages and it was a great user of the country's transport facilities. The emissaries of the G.E.C. were doing a great deal for British, colonial and foreign trade. The company was really pivotal in the economic life of the country, it was both a national and an international institution.

Mr. DRIVER, in proposing the health of "The Visitors," said that among their guests were both buyers and sellers of their goods, as well as the Press, which had been of considerable help to the company.

Mr. M. SOLOMON replied in a very amusing manner, causing a great deal of laughter by his reminiscences of his association with the company.

Mr. S. RENTELL responded on behalf of the Press, and expressed his gratification at the evidences of the firm's steady growth.

Mr. HEDEN, a former member of the staff, also replied.

Mr. FROST proposed the health of the Chairman, to whom, he said, the prosperity and progress of the Osram Lamp Works were due.

Mr. WILSON, replying, said that he had been connected with the Lamp Works for 30 years out of the 32 years of its existence. The fact that there were still with the company men who had started at the same time as himself was a tribute to the good spirit of the works. The G.E.C. had many ramifications, but, in his opinion, the Lamp Works stood at the head of the organisation. In conclusion, he thanked Mr. Adams for the excellence of the evening's arrangements, and Mr. Adams briefly responded. During dinner music was provided by the Weller-Langton quartette, and afterwards concert numbers were given by Messrs. C. Weller, W. Fisher, C. Warren, and H. Hearne, and Miss Isobel Leighton and Miss Edith Faulkner.

American Printing Telegraph Companies Amalgamate.—Long patent litigation between the two greatest printing telegraph companies in America, the Morkrum Company, of Chicago, and the Kleinschmidt Electric Company, of New York, which both manufacture telegraphic typewriting machines used by most of the telegraph and cable companies, ended in the consolidation of the two companies in Chicago on January 2nd. The new combination is to be known as the Morkrum-Kleinschmidt Company and will issue $1,500,000 in preferred stock and 10,000 shares of no par value common stock, none of which, however, will be on sale. The officials of the new corporation are Mr. Sterling Morton, president, and Messrs. Edward Kleinschmidt and Howard L. Krum, vice-presidents. Mr. Daniel Peterkin, of Chicago, will be treasurer and Mr. William Kleinschmidt, of New York, secretary.

Chinese Note.—A new cotton spinning and weaving mill has recently been completed at Liaoyang, in the province of Fengtien, by the Manchuria Cotton Spinning Co. Altogether 32,000 spindles and 500 looms have been installed, these being all electrically operated by power supplied by the Fushun Coal Mining Co.

New Belgian Company.—La Société de la Centrale Electrique de Zeebrugge has recently been formed with a capital of 4 million fr. to supply electricity for lighting and power purposes in the Zeebrugge district. The Société des Centrales Electrique des Flandres and the Société des Fours à Coke de Zeebrugge are interested in the new undertaking.

British Trade Mark Applications.—The following are among the recent applications for British trade marks. Objections against any of the proposed marks may be entered within one month from January 21st, 1925.

Melodex. No. 453,776. Class 8. Philosophical and scientific instruments and apparatus for useful purposes.—The Midland Radio Telephone Manufacturers, Ltd., Stourbridge.

Elka (lettering and animal design). No. 453,065. All goods included in Class 8.—Lewis Kremner, 55a and 104, Tib Street, Manchester.

Eldorado. No. 454,067. Class 50. Boards for insulation purposes in which cork is the predominating material.—Standard Cork Insulation Co., Ltd., 12, Holborn Viaduct, E.C.1.

The Electricity Supply Commercial Association.—We have received a copy of the official organ of this Association for December, which contains a review of the past year's activities. The E.S.C.A. was formed to bring together clerical and commercial employés of electricity supply undertakings as a means of protecting and furthering their interests. The work is naturally very difficult, as conditions vary so widely in almost every undertaking. A salary scheme has been drawn up, but as the employers of the industry have refused to form a joint council for the discussion of such matters, the Association is compelled to approach individual undertakings with not very marked success. So far only one undertaking has accepted the salary scheme, but during 1924 another company was prevailed upon to adopt the scheme in a modified form. Representations regarding unsatisfactory salaries and conditions have also been made to a number of undertakings, and although in some cases the Association was unable to obtain improvements, the Executive is assured that these representations have influenced employers to some extent. With the support of the E.T.U., with which the Association has working agreements, endeavours have been made to obtain representation upon the London District Council for the Electricity Supply Industry. So far this object has not been attained, but the Association is hopeful that some form of indirect representation, either by a separate sub-committee or by a joint conference with those employers who are willing to meet E.S.C.A. nominees, will materialise early in the current year. Having assisted in securing that employés shall be represented on Joint Electricity Authorities, the Association considers that it should appoint one of the representatives.

Another phase of the Association's activities is the holding of a "watching brief" in connection with new legislation. Particular reference is made to the Offices Regulation Bill and the Local Government and Other Officers' Superannuation Amendment Bill which affect members. The dissolution of Parliament stopped the latter Bill, but it is hoped that a similar Bill will be introduced in the near future.

The social side has been well looked after, and in pursuance of this the fifth annual concert is to be held at Anderton's Hotel, Fleet Street, on February 2nd. Tickets may be obtained from the general secretary, Mr. G. R. Smith, 7, Phineas Pett Road, Eltham, S.E.9.

Australian "Dumping" Duties Withdrawn.—The Commonwealth "dumping" duties on German "glass shades (including globes) for electrical, gas and lamp fittings" have been withdrawn.

Engineering Workers' Wages.—Mr. J. T. Brownlie, president of the A.E.U., addressing a meeting of employés in the engineering industries at Birmingham on January 20th, said that he was hopeful that the employers would concede an increase in the forthcoming spring. It was possible, however, that circumstances might arise when the workers would be asked to show their sincerity by "determined action."

Unemployment.—The number of persons registered as wholly unemployed during the week ended January 12th showed a decrease of 27,340 from the previous returns, the total being 1,279,800.

Vickers's Fulham Contract.—The contract for the extension of the Fulham municipal power station by the installation of two 6,000-kW turbo-alternators and the necessary auxiliary plant was awarded to Messrs. Vickers, Ltd., last year, in the face of strong foreign competition. A special feature of the contract is that the Vickers organisation is able to provide the whole of the plant, from the boilers to the switchgear. The sub-contractors include the following members of the Vickers group:—The Metropolitan-Vickers Electrical Co., Ltd., the Vickers-Spearing Boiler Co., Ltd., and Messrs. W. T. Glover & Co., Ltd. A 50-ton overhead electric crane is being supplied by Sir Wm. Arrol & Sons, Ltd. In view of the urgent necessity for more power, special efforts were made to complete the first set, and this was put into commission in December.

A Directory of Consumers.—A useful work of reference for contractors, retailers and other interested persons has been prepared by the Hackney Electricity Department. This is a directory of consumers, classified according to streets, giving some indication of the class of premises. The original price of the directory is 3 guineas, but this falls to 2 guineas after six months, and to a guinea after a year.

The Spanish Ambassador on Spain.—The address of Senor Don Alphonso Merry del Val, the Spanish Ambassador in London, at a luncheon given by the London Commercial Club, in November last, has been printed and circulated by the Club. In it there are many points of interest and information to British manufacturers and traders. Senor Merry del Val said that Great Britain's business relations with Spain might be vastly improved; the proof of this was the fact that other nations were improving theirs, very often at Great Britain's cost. Spain was a country of immense resources, both agricultural and mineral, and her population was increasing at the rate of a million in ten years, despite emigration. In 1923, trade with Great Britain represented 1.70 per cent. of all British imports and 1.35 per cent. of all British exports. In a number of lines, principally machinery and textiles, Great Britain was the leading importer into Spain. Spain was on the way to becoming an industrial nation, as was proved by the remarkable rise in the revenue derived from the special tax upon industrial establishments following upon the increased number of factories. In this development British capital had had a large share, as in naval construction, railway work, &c. There were 36 wholly British companies at work upon the enormous mineral resources of Spain, which covered an area of 3,963 sq. miles. Spanish transport was not adequate to the country's needs and possibilities, and it was one of the national aspirations to place it upon a proper footing. A British company had secured a concession for a direct railway line from Santander to Valencia, while an Anglo-Spanish company (Babcock and Wilcox Española) had become, in the face of hot competition, a regular purveyor of locomotives for the railways and steel tubes for the Navy and merchant service. Spaniards were ever more ready to expand their trade and industry on the most modern lines by establishing new and better business relations with foreign merchants and capitalists. British capital and technical advice for the development of Spanish resources were especially welcome. Senor del Val concluded the first part of his address with the advice to British traders to learn Spanish. The second part of the address was devoted to recent political events in Spain.

Swedish Engineering Industry.—In a review of the situation of the engineering industry, *Svensk Export* says that German competition has been felt intensely in many branches; the machine tool industry, in particular, has been badly hit, but is now becoming able to meet foreign competition. The improvement in gas engines is slow, the manufacturers of crude oil engines for the European market being exposed to German competition. The oversea markets are better; the Atlas-Diesel concern has delivered many rock drills to South Africa. The electrical industry finds a better market both at home and abroad, and the prospects of the telephone industry have brightened during the past few months.—*Reuter's Trade Service* (Stockholm).

Patent Restoration.—An order has been made restoring patent No. 7,375 of 1912 granted to Leo Sunderland and G. C. Pillinger for "Improvements in the electrical and automatic control of engines, dynamos and batteries, and improvements in the electrical and automatic control of engines, dynamos and batteries respectively."

Lighting and Power Notes.

Australia.—NEW SOUTH WALES.—In order to facilitate the electrical development throughout the country districts, the Government is investigating the State's water power—a task which will be completed at an early date. At the same time, the Government itself is extending, within the limits of its financial means, the establishment of power stations, both fuel and water. Already there is a plant at Port Kembla with a capacity of 3,600 kW, from which electricity is supplied to various localities over a wide area of the South Coast districts. The construction has also been authorised of a power station utilising the water power available from the Burrinjuck storage reservoir. Further schemes are in course of investigation for the Shoalhaven River and Hume reservoir.—*Reuter* (Sydney).

TASMANIA.—The *Industrial Australian and Mining Standard* states that the probability of the establishment of a paper and pulp industry at Burnie has called attention to the need for hydro-electric installations to serve the north-west of Tasmania. The Premier, Mr. Lyons, states that the Shannon scheme would prove the most suitable source, and has recommended the Government to proceed with the scheme as soon as a commitment is made in connection with the pulp and paper works at Burnie. The capital cost of the scheme would amount to £275,000, and the power available is 12,000 h.p.

Bedford.—LOAN.—The Electricity Committee has recommended to the Town Council that application be made for sanction to borrow £15,000 for the provision of a boiler and necessary auxiliaries.

Bethesda (North Wales).—OBJECTIONS TO ELECTRICITY SCHEME.—Objections have been raised to the proposed electricity scheme by local ratepayers, who have pointed out to the Council that the Gwynedd Trust has offered to supply current to the area on the same, or even more reasonable, terms than the Council can provide it. The Trust would, therefore, relieve the Council of great financial liabilities. The Council has replied that the Gwynedd Trust scheme would not cover the whole of the area, and would leave out districts which the Council considered should be included. The Council pointed out that its gasworks could not cope with the increasing demand for gas for lighting purposes.

Brazil.—ELECTRICAL DEVELOPMENT.—Wileman's *Brazilian Review* gives an account of the inauguration of the additional power supply at Ilha dos Pombos for the Rio de Janeiro Tramway, Light and Power Co., Ltd. The station is on the Parahyba River, a short distance from Antonio Carlos on the Leopoldina Railway. Two generators, driven by water turbines, with a capacity of 30,000 h.p. each, have been installed. The transmission line, carried on steel towers, between the power house and the Cascadura station of the Light and Power Co., is about 96 miles in length. Although initially being operated at 88,000 V, the line is constructed with provision and insulation for ultimate operation at 132,000 V. The average length of span in this transmission line is 550 metres, but the maximum span attains a length of approximately 1,400 metres. Provision has been made in constructing the power station for the installation of additional plant when required.

Brighton.—NEW PLANT.—In order to meet the anticipated increased load for the winter of 1926, the Corporation electrical engineer has recommended that the 2,500-kW set installed in 1904 be scrapped and replaced by a 6,000-kW set. A machine of 6,000-kW capacity was installed in 1924 at a cost of £29,595.

Cannock.—ELECTRICITY EXTENSIONS.—Electricity extensions involving an expenditure by the Urban District Council of about £10,000 are to be carried out. The houses being erected by the Littleton Collieries, Ltd., the Mid-Cannock Colliery Co., and Lewis's Rosemary Tileries, Bridgtown, are to be wired for electricity.

Colwyn Bay.—SPECIAL ORDER.—The Urban District Council has applied for a Special Order authorising it to extend its area of electricity supply so as to include certain parishes in the counties of Carnarvon and Denbigh.

Conisborough.—LIGHTING FOR COUNCIL HOUSES.—The Urban District Council has been notified by the Electrical Distribution of Yorkshire, Ltd., that it is prepared to provide electricity for lighting 210 Council houses at a charge of 25s. per house for service cables.

Continental.—FRANCE.—The Town Council of Colommiers has opened negotiations with the Energie Industrielle with a view to obtaining a supply of electricity in the city and surrounding districts, the city advancing 200,000 fr. towards the cost. Work on the scheme will be started in May.

The Société d'Electricité de la Région de Valenciennes-Anzin has secured official approval to set up five transmission lines to serve a number of communes, two lines being underground and three overhead. The current will be transmitted at a pressure of 10,000 V and stepped down to requirements.

SWITZERLAND.—It is reported from Berne that the Baden-Swiss Rhine Commission has approved plans for the establishment of three large hydro-electric stations to utilise the water power of the River Rhine between Basle and Schaffhausen. One of the stations is to be established at Reck-

ingen. Five turbo-generators are to be installed with an output of 167 million kWh per annum. The second station will be situated at Dogern; it will eventually be equipped with 12 turbo-generator sets for an average output of 410 million kWh. The third plant, which is to be established at Niederschworstadt, will be equipped with four generating sets of 27,000 h.p. each, provision being made at the station for the installation of a fifth set of the same capacity at a later date.

Dolgelly.—ELECTRICITY SCHEME REJECTED.—The Electricity Commissioners have informed the Urban District Council that they have decided not to approve the application of the Cambrian Electricity Supply Corporation, Ltd., for a Special Order to establish an electricity undertaking in the town, as they are not satisfied with the proposals of the promoters as to the manner in which the necessary capital will be provided.

Doncaster.—LINKING-UP COLLIERIES.—A new line of cable, about seven miles in length, is about to be laid which will link up the Yorkshire Main Colliery at Edlington with Hickleton Main Colliery, and the completion of this will put an electrical girdle round Doncaster. The line may later be extended to Frickley, bringing in Grimethorpe and the Brierley pits, which are now building a central power station for transmitting power at 20,000 V. Each pit in the Markham group has its power station, and the idea is to guard against effects of a breakdown. The Doncaster Corporation and the Doncaster railway works are taking part of the surplus energy generated.

Durrington (Salisbury).—ELECTRICITY SCHEME.—A committee has been formed to arrange for the flotation of a local company to carry out an electric lighting scheme. The suggested capital is between £2,500 and £3,000, and it is proposed to purchase electricity in bulk from the War Department.

Elland.—STREET LIGHTING.—The Urban District Council has installed automatic control of the street lighting in the East Ward area, and has found it so satisfactory that the system is now to be extended to the West Ward.

Harwich. — INAUGURATION OF SUPPLY.—The electricity undertaking for the town was formally inaugurated on January 21st, the Mayor switching on the supply. Electricity is obtained in bulk from the London & North-Eastern Railway Co. The electrical engineer is Mr. E. Jordon.

Halifax.—TRACK RENEWALS.—The work of reconstructing the tramway track on the Calder Valley routes has commenced after years of consideration.

Helensburgh.—ELECTRICITY SCHEME.—The Town Council is applying for an Order for an electricity scheme. It is understood that the Clyde Valley Power Co. will work the undertaking.

London.—BATTERSEA.—The report on the working of the borough electricity undertaking (engineer: Mr. F. A. Bond) for the year ended March 31st last shows that the gross profit for the year was £29,190. Loan charges, interest, and contributions to superannuation fund amounted to £26,492, the remaining surplus being £2,698, from which sum the cost of works of a capital nature and the deficiency on the installation and sales account amounting to £1,524 have been met, the net surplus being £1,173. The energy sold totalled 8,882,413 kWh, as compared with 8,083,349 in the previous year, an increase of approximately 10 per cent. The increase in the output since 1914 was 68 per cent. 664 new services were laid during the year, as compared with 243 in 1922-23.

ST. PANCRAS.—*New Plant.*—The Borough Council has received sanction to the installation of a 10,000-kW turbo-alternator and the necessary auxiliary plant, and to a loan of £43,000 for the purchase of the plant.

Street Lighting.—The Electricity Committee has recommended that 701 street lamps be converted from gas to electricity at an estimated capital cost of £6,007.

POPLAR.—The Borough Council has received sanction to loans amounting to £90,708 for the provision of part of the new plant required for the 1925 extensions.

Lowestoft.—ELECTRICITY IN BULK.—The town clerk, the general manager, and the electrical engineer have had a conference with the chairman of the Electricity Committee, the town clerk, and electrical engineer of Great Yarmouth with regard to the question of taking a supply of electricity in bulk from the latter Corporation. The matter is receiving consideration, and in accordance with a suggestion of the Electricity Commissioners discussions have also taken place with representatives of Norwich Corporation in order to ascertain whether it would be possible for a bulk supply to be obtained from that city.

Leigh.—ELECTRICITY SUPPLY.—The Town Council has decided to take a supply of electricity for a period of six months from the Lancashire Electric Power Co.

Mansfield.—LOAN.—The Town Council has applied for sanction to a loan of £5,750 for mains.

Newton Stewart.—PROPOSED ELECTRICITY SCHEME.—There is a proposal to introduce electric lighting to the town at a cost of £6,000.

Northern Ireland.—DONEGAL.—The Asylum Board has appointed a committee to discuss with the Letterkenny Urban District Council the question of a joint electric lighting scheme for the town of Letterkenny and the Donegal Mental Hospital. It is proposed to utilise the River Lennan at Kilmarcrennan for generating electricity.

KILLYBEGS (Co. DONEGAL).—The electricity scheme for the district was recently inaugurated, the Bishop of Raphoe switching on the supply.

Oundle.—ELECTRICITY SUPPLY.—The Urban District Council has approved the application of the Rushden and District Electric Supply Co., Ltd., for a Special Order to extend its area of electricity supply to the urban district. The Rural Council has deferred consent, as it is of opinion that the rural area might obtain a cheaper supply of electricity from Peterborough.

Preston.—ELECTRICITY EXTENSIONS.—The Electricity Committee has recommended to the Town Council that the following extensions be carried out:—Additional h.p. mains from the Crown Street sub-station to Ashton, Fulwood, Penwortham, and Ribbleton (£3,000); an additional transformer at Crowin Street sub-station (£1,565); extension of the h.p. main over Penwortham Bridge to supply the south side (£1,600); new h.p. switchboard at Crowin Street (£900).

Price Reductions.—Reductions in the charges for electricity have been made or recommended in the following districts:—

PORTSMOUTH.—Power, heating and cooking, outside the borough: First 5,000 kWh per annum, 1½d. per kWh; the second 5,000 kWh, 1¼d. per kWh; next 10,000 kWh, 1d. All energy in excess of 20,000 kWh per annum, 1½d. per kWh.

ALLOA.—Power: First 1,250 kWh per quarter, 3d. per kWh; next 5,000 kWh, 2½d.; beyond, 2d. per kWh.

HECKMONDWIKE.—Lighting: 6d. per kWh, plus 20 per cent. less discounts varying from 5 to 20 per cent., according to the quantity consumed.

Stafford.—NEW PLANT.—In connection with the Town Council's electricity extension scheme, the provision of the following plant is proposed:—One 3,000-kW turbo-alternator, £15,510; one 4,000-lb. boiler, £10,500. It is also proposed to lay a main to the site of the British Reinforced Concrete Co.'s new works at a cost of £4,000.

Thornton (Lancs.).—ELECTRICITY IN BULK.—The local Council proposes to exercise its powers under its 1914 Electric Lighting Order, and is to obtain from Blackpool Corporation terms for a bulk supply.

Twickenham.—ELECTRICITY CHARGES.—At a meeting of electricity consumers at the Town Hall on January 20th, a resolution was passed protesting against the charges made by the Twickenham and Teddington Electric Supply Co., Ltd., and requesting the Electricity Commissioners to hold an inquiry on the subject. It was also urged that the electricity undertaking should be taken over by the local public authority.

West Gloucestershire.—SPECIAL ORDER.—The West Gloucestershire Power Co. is applying for a Special Order authorising it to extend its area of electricity supply to the rural districts of Newent, Gloucester, Cheltenham, Tewkesbury, and Monmouth, and certain parishes in the rural districts of Chepstow and Pontypool.

Walsall.—ELECTRICITY SUPPLY.—The Town Council has sanctioned an expenditure of £4,000 on mains and plant in connection with the supply of electricity to Lichfield.

Winchester.—ELECTRICITY EXTENSIONS.—The Town Council has offered to give a supply of electricity to the premises of John I. Thornycroft & Co., Ltd., until the end of 1927. The maximum demand is not to exceed 500 h.p., and the firm is to guarantee a minimum consumption of 500,000 kWh per annum. The cost of the cable to be provided by the Council is estimated at £2,200. The Council has decided to install a Diesel engine direct-coupled to a generator of 410-kW capacity, at an approximate cost of £8,300, and a loan of £10,500 is to be applied for to meet the cost of the cable extension and the motor generator.

Tramway and Railway Notes.

Australia.—VICTORIA.—According to the *Industrial Australian and Mining Standard*, in moving the second reading of the Railway Loan Application Bill, in the Legislative Assembly (Vic.), the Treasurer (Sir Alexander Peacock) said that the Bill was to provide for the capital expenditure estimated to be incurred for railway purposes during the 12 months ended September 30th, 1925. The amount provided in the Bill is £1,875,000. The following items are included:—Electrification of the Ringwood to Lilydale, and Ringwood to Ferntree Gully lines, £119,105; installation of power signalling on Melbourne suburban lines, £80,000; additions to power house, sub-stations, &c., in the electrical operation of Melbourne suburban lines, £100,000.

SYDNEY (N.S.W.).—Preliminary tests of different parts of the equipment for the conversion of trains on the Illawarra

(N.S.W.) line from steam to electric traction were recently held and were successful. A length of nearly three miles of line between Rockdale and Sydenham was prepared for the tests. The current for the purpose was supplied from the new rectifier sub-station at Tempe. It will be at least twelve months before a regular electric train passenger service will be inaugurated.

Brighton.—NEW ROUTE.—The Tramways Committee has recommended to the Town Council that steps be taken to obtain an Order for the extension of the Lewes Road tramway to the north end of the Moulscombe estate.

RAILLESS CARS.—It is proposed that the Tramways Committee prepare a report as to the desirability of running railless cars instead of the present trams from the Aquarium to the station in view of possible traffic difficulties at the station gates and the financial loss incurred on the route.

Continental.—SWEDEN.—Trials of the electrified line connecting Stockholm and Gothenburg have been delayed until next spring. Contracts call for the delivery of 50 electric locomotives on October 1st, 1925. As this railroad handles through cars in international traffic, means of heating either by steam or electricity will be provided. The line is 458 km. in length.

ITALY.—It is reported that a scheme for the construction of an underground railway for the entire length of Venice has been submitted to the Municipal Technical Bureau by an engineering concern. The cost of the scheme is estimated at £1,000,000, and it would be completed within five years. Opposition to the proposal is being made by the residents.

SWITZERLAND.—It is reported from Geneva that a large electrical concern in that city is negotiating for the contract for the electrification of the Bodensee (Lake Constance)-Toggenburg railway.

Trial runs have been made over the newly-electrified section of the Swiss Federal railways between Zurich and Olten and between Lausanne and Yverdon, and the lines were opened for traffic last week.

Halifax.—FARES.—The Tramways Committee has decided to revise the fares. From April 1st the fares on the long-distance routes will be reduced by 25 per cent., and 1d. stages are to be lengthened.

Huddersfield.—TRAMCARS v. 'BUSES.—At a meeting of the Town Council on January 21st, the chairman of the Tramways Committee made a statement on the subject of the competition between tramways and motor-'buses. He said that in the year since penny fares were reintroduced the tramways of the borough had carried 3,493,791 more passengers than in the previous corresponding period, but there was a decrease of £15,884 in receipts. It was the Corporation's duty to see that the undertaking did not suffer from unfair and undue competition. The Committee did not object to long-distance 'buses, but to competition with the trams at the various tram termini. The Committee would itself use 'buses to preserve the tramway receipts.

Irish Free State.—DUBLIN.—The undertaking of the Dublin and Lucan Electric Railway Co. was to be closed down on January 29th.

London.—THE BANK UNDERGROUND STATION.—The reconstruction of the Bank station of the Central London Railway, which has been proceeding for the past 18 months, is now completed. About 8,000,000 passengers use the Central London station in the course of a year. The improvements that have been effected render the station capable of dealing with 12,000,000 passengers annually. The adjacent station of the City Railway has a yearly traffic of 6,000,000 passengers.

THE "UNDERGROUND" COLLISION.—The Underground Electric Railways Co., of London, Ltd., has issued the following statement regarding the collision briefly reported in our last issue:—On Monday, January 19th, a slight collision occurred at Charing Cross on the Hampstead line, in which the driver and guard sustained injury. No passengers made complaint, and all proceeded on foot to the adjoining station. The accident was not occasioned by any failure or defect in the automatic signalling. Abnormal working had been instituted to deal with the failure of a train at Charing Cross. This failure was on the single line loop where the extent of vision is restricted. The driver of the following train was proceeding at caution. The accident was due to a misunderstanding, on the part of the driver, of the emergency instruction given at the Strand station, as to how far he was to proceed.

These three elements in the accident are wholly unlikely to recur simultaneously, but further measures are being taken to avoid any possibility of this risk of misunderstanding being repeated. The disabled trains were removed shortly after mid-day, and the full normal service again established by about 4 p.m.

Manchester.—TRAMWAY AGREEMENT.—A dispute between Manchester and Stockport over the running of tramcars between the two districts was recently settled at a meeting of the Tramways Committees of the two Corporations. The service between Piccadilly, Manchester, and St. Peter's Square, Stockport, will in future be worked by Stockport cars only, while the service between Manchester, Stockport, and Hazel Grove will be in the hands of Manchester Corporation.

Middlesex.—METROPOLITAN ELECTRIC TRAMWAYS.—The *Financial Times* reports that the Middlesex County Council is promoting a Bill in the next session of Parliament for power to renew the lease of its light railways, which are at present worked by the Metropolitan Electric Tramways under a lease expiring on December 31st, 1930. It is proposed that the new term shall not exceed 30 years, and in addition to the light railways, the lease may include the tramways of the Council. In the event of the light railways and tramways being leased to the company, the Bill provides that the London General Omnibus Co. and the Underground Electric Railways Co. may jointly or separately guarantee the payment by the company of all rents and other payments due to the Council. The Bill also provides that during the existence of any lease of the light railways and tramways, the existing tramways of the company in Edmonton, Tottenham, Wood Green, and Willesden shall not be purchased by the Council or any other local authorities.

Reading.—FARES.—The Town Council has approved a proposal of the Tramway Committee that tramway tickets be issued in batches of 12 at a reduction of about 16 per cent. The scheme will be introduced on March 6th.

Southern Railway Electrification.—According to the *Daily Telegraph*, of the several important sections of the Southern Railway suburban lines now being electrified, portions of the new services will be available to the public in the near future. In March the extension of the London and Brighton line from Croydon to Sutton will be opened. In July the South-Western extensions from Surbiton to Guildford, and from Raynes Park to Dorking, will be ready for use. On the South-Eastern a new line from Victoria and Holborn to Orpington is timed to be opened in July, and the alternative route to Orpington and Beckenham Junction from Charing Cross and possibly Cannon Street will, it is hoped, be ready in December. Between March and May, 1926, the electrification of the lines from Cannon Street, Charing Cross, and London Bridge, by the four routes to Dartford, is expected to be finished. An official of the company states that by March, 1926, 537 new carriages will be brought into use.

United States.—UNDERGROUND RAILWAY.—The first section of an underground railway was recently completed in the city of Rochester, N.Y. When the system is completed the total length of the line will be 8¼ miles.

Telegraph and Telephone Notes.

Czecho-Slovakia.—LONG-DISTANCE TELEPHONY.—A beginning has been made with the laying of the long-distance cable between Prague and Kolin. The construction of direct telephone circuits between Prague and Trieste is practically completed so far as the Czecho-Slovakian portion is concerned. On the Italian portion the work is so far advanced that traffic is expected to be possible early this year. Hereafter communication will be established with Paris, through Nuremberg and Strassburg, the constructive work being prosecuted actively, both on the French and the German sides of the frontier.

China.—LONG-DISTANCE TELEPHONY.—The long-distance telephone service between Tsinan and Tsingtao, which was established by the Japanese but suspended for a time, will shortly be resumed. A set of new apparatus has been installed in Tsinan.

Denmark.—DEARER TELEPHONE RATES.—The Copenhagen telephone system is in the hands of a private company, which, after application to the Department of Public Works, has received permission to increase some of its charges. From January 1st, 1925, each new subscriber on 4-party lines will have to pay an installation or entrance fee of 120 kronor, instead of 20 kronor (say, 28 kronor=£1); each 2-party line subscriber will have to pay 160, instead of 60, kronor; each subscriber with a single line will have to pay 200 kronor, instead of 100 kronor. Each new subscriber to "Huvudcentral," which is the chief exchange in Copenhagen, will have to pay an installation fee of 300 kronor, instead of 100 kronor. The increased rates are due to heavy installation costs; the annual subscription will be increased by 10 kronor from July 1st, and for subscribers on Huvudcentral the increase will be 20 kronor. More money must be put aside for depreciation. It is hoped the increased entrance fees will reduce the excessive demand for new lines. The installation costs per line were 500 kronor in pre-war days, and are now 700 kronor. For the last five years there have been 7,000 new subscribers annually. The company does not want to apply for a large increase of capital now, and wants the revenue to pay for some of the increased installation cost.

France.—REVISED TELEPHONE RATES.—A new system of telephone charges is to be introduced at the beginning of next month in three of the Paris telephone exchange areas. Hitherto, the inclusive annual subscription for a single installation has been 700 fr. (about £8). Under the new system every call will be charged for at the rate of 15 centimes. The minimum subscription will be 300 fr., which covers the first 2,000 calls. This method is to be introduced in due course all over the Paris area.—*The Times.*

Greece.—RADIO STATION DAMAGED.—Owing to extensive damage done to the emplacement of the Botanicos radio station it is announced that no service will be available for two or three months.—*Reuter* (Athens).

India.—TRUNK TELEPHONY.—It is reported that a new trunk line telephone service between Bombay and Delhi is to be inaugurated next month. The *Financial News* says that experiments have been made in composite working, and the use of telegraph wires for telephony between Bombay and Nagpur, and Calcutta and Nagpur, with a view to linking Bombay with Calcutta. It is hoped to have successful direct communication between the two cities within two years.

Italy.—TELEPHONE TRANSFER.—An official communiqué says that the transfer of the telephones in Italy to private industry has now been effected as regards the Piedmont-Lombardy, Venetian, Liguria-Tuscany-Latium, and Sardinian zones. The concession for the Calabria-Puglia-Basilicate-Campanie-Sicily zone has not yet been awarded, the commission having asked for more time. The Government has decided to entrust the inter-provincial, inter-regional, and international telephones to an enterprise which will be under the direct control of the State in order that these systems of communication shall not be in the hands of a company with foreign participation.—*Reuter's Trade Service* (Rome).

New Atlantic Cable.—INAUGURATION.—The Western Union Telegraph Co. announces that the new cable between New York and Malaga, *via* the Azores, was opened to public traffic on January 19th. On the same day the shore end of the section, which will prolong this new cable from Malaga to Italy, was landed at Anzio.—*The Times.*

The Telephone Service.—CAB EXCHANGES.—At the instance of the Post Office authorities the police are investigating the feasibility of setting up taxi-cab telephone exchanges in London and the larger cities. The authorities have, says the *Daily Telegraph*, examined systems in operation on the Continent, by which a telephone subscriber can be connected directly with a taxi exchange, which will send a taxicab to the address desired from the nearest rank at which a cab is available. All the cabranks in Stockholm, for example, are linked to one central exchange.

NEW EXCHANGE.—It is reported that Acton is to be provided with a separate telephone exchange.

Pacific Cable.—DUPLICATION.—As announced in its annual report, which is abstracted elsewhere in this issue, the Pacific Cable Board is now ready to proceed with the laying of a second cable from Vancouver to Fiji to complete the duplication of the cable from Canada to Australia and New Zealand, as the section south of Fiji was doubled in 1923. According to *The Times*, the Board by advertisement has invited British manufacturers to tender for the manufacture and laying of 3,625 nautical miles of submarine telegraph cable between Bamfield, Vancouver, and Fanning Island, and also for the further length of 2,171 nautical miles between Fanning Island and Suva, Fiji. It is expected that the work will occupy about 18 months.

Radio Notes.

Broadcasting in Schools.—L.C.C. DECISION.—The London County Council Education Committee has decided to limit the reception of broadcast lectures in school hours to the last half-hour on Friday afternoons, says the *Daily Mail*, as the inspectors' reports on the experiment are unfavourable on educational grounds and on the quality of the reproduction.

Broadcasting Plays.—COMMITTEE MEETING.—On January 26th the Committee appointed by the British entertainment industry to consider theatrical broadcasting held its first meeting. The B.B.C. was represented, and a further meeting was arranged for next week. Meanwhile, the B.B.C. will not make new agreements to broadcast theatrical productions, but will adhere to its present commitments. Most theatre managers are still convinced that broadcasting is a competitor, and therefore not to be encouraged, but the *Morning Post* says the Committee had its hand forced by the action of the managers who had broadcast their shows, and because of the undoubted financial benefit that has accrued to the box-offices concerned.

The *Evening News* reports that after listening in Berlin to the broadcasting of a portion of "Charlot's Revue" from the Prince of Wales Theatre, M. Klement, the Viennese adaptor of English plays, chartered an aeroplane for London. Negotiations for the production of the revue in Central Europe have reached a satisfactory stage.

The Sun's Eclipse.—RADIO RECEPTION IMPROVED?—Advantage was taken of the eclipse of the sun on January 24th by the broadcasting companies of Great Britain and America to note the effect of light. The British company, through the London and Aberdeen stations, from two o'clock until four p.m. sent out a continuous programme of pianoforte solos, and every half-hour during that period gave the Greenwich time signal. In London a feature was that American stations, which have usually hitherto been picked up only at night, were heard, and in one instance, while the sun was shining brilliantly—a very unusual phenomenon. The reception of 2 LO in London appeared to be distinctly better during the eclipse, and at Cambridge Prof. Appleton noticed a change of signals exactly similar to that which usually occurs at sunset. Prof. Finlay, who was listening at Cambridge, but to the Aberdeen special transmission, noticed a distinct increase in the strength of reception.—*Daily Telegraph.*

United States.—WAVELENGTH.—We hear from New York that the idea of re-allocating the wavelengths of American broadcasting stations as recommended by the U.S. Secretary of Commerce at the recent national radio conference has been abandoned by the U.S. Department of Commerce. The plan which had been formulated has been rendered obsolete by the increasing number of broadcasting stations throughout the United States, and it is understood that no attempt will be made to revise the present allocation until the situation becomes more stable.

Contracts Open and Closed.

(The date given in parentheses at the end of the paragraph indicates the issue of the ELECTRICAL REVIEW *in which the "Official Notice" appeared in our advertisement pages.)*

Open.

Australia.—SYDNEY.—March 30th. Municipal Council. Maximum demand indicators.*

MELBOURNE.—March 4th. Victorian Government Railways. Telephone equipment.*

April 1st. Electrical equipment for motor coaches and trailers.*

Postmaster-General's Department. March 10th. Primary battery parts.*

Bedford.—February 12th. Electricity Committee. Replacing, altering, and rewinding single-phase a.c. motors and the modification of motor-driven machinery, where necessary, on consumers' premises. (January 16th.)

Belfast.—February 9th. L.M. & S. Rly. Northern Counties Committee (Ireland). Twelve months' supply of stores, including telegraph ironwork, wire, electric lamps, porous pots, &c. Forms (6d.) from Mr. P. J. Martin, stores superintendent, York Road Station, Belfast.

Bredbury.—February 2nd. Bredbury and Romiley U.D.C. Supply and laying of 4-core lead-covered l.p. distributor cable. (January 16th.)

Brandon and Byshottles.—February 14th. Urban District Council. Poles, &c., for street lighting and overhead mains on Meadowfield housing site. Plans, &c., from Mr. J. Plummer, Engineer's Offices, Brancepeth Colliery, Willington, Co. Durham.

Bridlington.—February 16th. Electricity Works. One 600-kW steam turbine, reduction gear, and d.c. generator. (See this issue.)

Chile.—SANTIAGO.—March 2nd. State Posts, Telegraphs and Telephones Department. Telegraph material, including copper wire, insulators, &c.*

Croydon.—March 2nd. Electricity Department. 60,000-lb. water-tube boiler equipment. (January 23rd.)

Finland.—HELSINGFORS.—April 1st. Government Water Power Department. Materials for the sector sluice and turbine chambers for the equipment of the hydro-electric plant at Imatra.*

France.—March 10th. French Post and Telegraph authorities, 103, Rue de Grenelle, Paris. 52 lots of telephone apparatus with integral central battery of the 1924 model.

Glasgow.—February 2nd. Corporation. Electric lighting installation in Govan Town Hall. Mr. R. B. Mitchell, 75, Waterloo Street.

Hull.—February 19th. Electricity Committee. Four water-tube boilers and accessories. (January 16th.)

India.—March 9th. Bombay, Baroda, and Central India Railway Co. Electrification of Bombay suburban lines:—Overhead equipment of permanent way and overhead transmission and distribution lines. (January 23rd.)

Latvia.—RIGA.—February 23rd. Marine Department. Two four electrically-driven cranes.*

Lochgelly (Fife).—February 4th. Town Council. Electric lighting installation at Council's houses (housing scheme). Particulars from Town Clerk.

London.—METROPOLITAN WATER BOARD.—February 11th. Twelve months' supply of stores, including electric lamps. Chief Engineer, Metropolitan Water Board, 173, Rosebery Avenue, E.C.

H.M. OFFICE OF WORKS. February 12th. C.i. switches and fuseboards. (See this issue.)

HAMMERSMITH.—February 18th. Electricity Department. Twelve months' supply of stores, including electrical goods, insulated wires, meters, l.p. cable, &c. (See this issue.)

Manchester.—February 2nd. Electricity Committee. Three 1,000-kW motor converters or rotary converters: 11 750-kW do. do.; five 3-wire automatic balancers; two negative boosters. (January 16th.)

February 10th. Tramways Committee. Permanent-way special track work. Mr. H. Mattinson, general manager and chief engineer, Corporation Tramways, 55, Piccadilly, Manchester.

Newport (Mon.).—February 2nd. Electricity Department. E.h.p. and l.p. switchgear. (January 16th.)

New Zealand.—WELLINGTON.—April 14th. Public Works Tender Board. Sub-station switchgear extensions for the Lake Coleridge power scheme.*

Post and Telegraph Department. March 15th. Switches and diaphragms.*

Plymouth. — February 4th. Electricity Department. Twelve months' supply of electricity meters, cables (paper insulated), and transformers. (See this issue.)

South Africa.—JOHANNESBURG.—February 11th. Municipal Council. 50-h.p. electric motor.*

Southport. — February 9th. Electricity Department. 9000 yd. l.p. paper-insulated cables (various sizes). (January 23rd.)

Tanfield (Co. Durham).—February 19th. Urban District Council. Overhead line, underground h.p. cable, and sub-station equipment. (January 23rd.)

Transylvania.—TIMISOARA.—March 26th. Municipal Electricity Works. Turbo-generator, Scott transformers, h.p. feeder and accessories.*

Tynemouth.—February 10th. Electricity Department. One 250-kVA and one 400-kVA transformers. (January 23rd.)

Uruguay.—MONTEVIDEO.—March 3rd. State Electricity Works. Metal-filament lamps.*

March 5th. Steel and phosphor bronze wire, steel and copper bars and sheets.*

March 6th. Round steel bars, iron rods, flat iron rods, sheets, &c.*

March 9th. 4,500 metres, g.i. water tubes and 47,115 fittings for same.*

March 10th. Miscellaneous goods (including flexible steel cable, &c.).*

March 16th. Porcelain insulators and brackets.*

Warrington.—February 16th. Electricity Department. Motors and transformer. (See this issue.)

*Further particulars can be obtained at the Department of Overseas Trade (Inquiry Room), 35, Old Queen Street, S.W.1.

Closed.

Australia.—SYDNEY.—Public Works Department.—According to the Australian Press, the English Electric Company of Australia, Ltd., has secured a contract to make in Australia eight 66,000-V power transformers for use in connection with the Burrenjuck hydro-electric system.

Brighton.—Electricity Committee. Accepted:—

Cables.—Macintosh Cable Co., Ltd.

Croydon.—Electricity Committee. Recommended:—

Equipment of two blank cubicles, one to control the second 10,000-kW machine and one for another feeder, and installing and equipping two further feeder cubicles to control the new feeders (£3,656).—English Electric Co., Ltd

Glasgow.—Tramway Committee. Recommended:—

Steel car wheels (w.i. centres).—I. Baker & Co., Ltd.
Electric tractor.—British Electric Vehicles, Ltd.
D.c.c. wire.—Manchester Armature Repair Co., Ltd.

Libraries Committee. Accepted:—

Completion of the electrical installation at Partick Library.—R. J. Sinclair.

Government Contracts.—The following Government contracts were placed during December, 1924:—

ADMIRALTY CONTRACT AND PURCHASE DEPARTMENT.

Battery gear.—Chloride Electrical Storage Co., Ltd.; D.P. Battery Co., Ltd.
Inert cells.—Edison Swan Electric Co., Ltd.
Secondary cells.—London Battery & Cable Co., Ltd.
Electric travelling jib crane.—Sir W. Arrol & Co., Ltd.
Units for vane condensers.—Sparklets, Ltd.
Fuses.—Wholesale Electrical Co. (1922), Ltd.
Diesel generating sets.—Vickers, Ltd.
Electric lamps.—General Electric Co., Ltd.; Edison Swan Electric Co., Ltd.; Metro-Vick Supplies, Ltd.; Siemens & English Electric Lamp Co., Ltd.; British Thomson-Houston Co., Ltd.
Motor-generators and spares.—Small Electric Motors, Ltd.; Newton Bros. (Derby), Ltd.
Motor-generator, switchgear and spares.—W. Canning & Co.
Motors, regulators and switches.—Bulpitt & Sons.
Motors, control gear and spares.—Verity, Ltd.
Transformer plant.—General Electric Co., Ltd.
Wireless telegraph amplifiers.—H. W. Sullivan, Ltd.
Wireless telegraph apparatus.—Marconi's Wireless Telegraph Co., Ltd.

WAR OFFICE.

Aluminium ingot.—British Aluminium Co., Ltd.
Copper sheet.—British Insulated & Helsby Cables, Ltd.
Generating sets.—W. H. Dorman & Co., Ltd.; Ruston & Hornsby, Ltd.
Turbo-generating set.—Greenwood & Batley.
Bronze wire.—T. Bolton & Sons, Ltd.
Milliammeters.—Elliott Bros., Ltd.
Electric lighting installations.—Normanton Barracks, Derby: Brightside Foundry Co., Ltd. Glen Parva Barracks, Leicester: John Collier and Co., Ltd. Old Granby Barracks and married quarters at Elphinstone, and Lambhay Hill: W. J. Corse & Co.; Depôt Barracks, Lincoln: A. Higginbotham & Sons.

AIR MINISTRY.

Accumulators.—Chloride Electrical Storage Co., Ltd.
Magnetos.—British Thomson-Houston Co. Ltd.
Wireless telegraph valves.—Mullard Radio Valve Co., Ltd.; General Electric Co., Ltd.
Voltmeters.—E. Turner.
Inert batteries.—Edison Swan Electric Co., Ltd.

POST OFFICE.

Telephone apparatus.—Automatic Telephone Manufacturing Co., Ltd.; British L.M. Ericsson Manufacturing Co., Ltd.; General Electric Co., Ltd.; Siemens Bros. & Co., Ltd.; Sterling Telephone & Electric Co., Ltd.; Western Electric Co., Ltd.
Testing apparatus.—Power Equipment Co., Ltd.; Siemens Bros. & Co., Ltd.; H. W. Sullivan, Ltd.; Walters Electrical Manufacturing Co., Ltd.; Western Electric Co., Ltd.
Cables (various).—Connollys (Blackley), Ltd.; Enfield Cable Works, Ltd.; W. T. Glover & Co., Ltd.; W. T. Henley's Telegraph Works Co., Ltd.; Union Cable Co., Ltd.; Western Electric Co., Ltd.
Joint box castings.—Ladywood Iron Works, Ltd.
Loading coils.—General Electric Co., Ltd.; Western Electric Co., Ltd.
Insulators.—Bullers, Ltd.; Doulton & Co., Ltd.
Lead sleeves.—Locke, Blackett & Co., Ltd.
Troughing.—Calders, Ltd.
Bronze wire.—T. Bolton & Sons, Ltd.; British Insulated & Helsby Cables, Ltd.; R. Johnson & Nephew, Ltd.; Shropshire Iron Co., Ltd.; F. Smith & Co. (incorporated in the London Electric Wire Co. and Smiths, Ltd.).
Copper wire.—T. Bolton & Sons, Ltd.; British Insulated & Helsby Cables, Ltd.; Elliott's Metal Co., Ltd.; Enfield Cable Works, Ltd.; R. Johnson & Nephew, Ltd.; Johnson, Clapham & Morris, Ltd.; Pirelli-General Cable Works, Ltd.; Shropshire Iron Co., Ltd.; F. Smith and Co. (incorporated in the London Electric Wire Co. & Smiths, Ltd.); J. Wilkes, Sons & Mapplebeck, Ltd.
Flame-proof wire.—Macintosh Cable Co., Ltd.
Manufacture, supply, drawing-in and jointing cable.—Northampton-Rugby: Western Electric Co., Ltd.
Electric lifts, Leeds H.P.O.: W. Wadsworth & Sons, Ltd.
Telephone exchange equipment.—Southwick (Brighton) and Eastbourne: Siemens Bros. & Co., Ltd. Central (London): Automatic Telegraph Manufacturing Co., Ltd City: Automatic Telegraph Manufacturing Co., Ltd. Woking: Automatic Telephone Manufacturing Co., Ltd. Guildford: British L.M. Ericsson Manufacturing Co., Ltd Uxbridge: Western Electric Co., Ltd. Burnley: General Electric Co., Ltd.; sub-contractors: D.P. Battery Co., Ltd., for batteries; Crompton & Co., Ltd., for machines.

H.M. OFFICE OF WORKS.

Engineering services.—Electric lift, Home Office, S.W.: Etchells, Congdon & Muir, Ltd. Royal Courts of Justice: W. Wadsworth and Sons, Ltd.

CROWN AGENTS FOR THE COLONIES.

H.p. cable, &c.—British Insulated & Helsby Cables, Ltd.; Callender's Cable & Construction Co., Ltd.
Aerial cable, &c.—W. T. Henley's Telegraph Works Co., Ltd.
"Lux" cells.—Chloride Electrical Storage Co., Ltd.
Train lighting equipment.—J. Stone & Co., Ltd.
Telegraph ironwork.—Bullers, Ltd.
Telephone switchboard.—British L.M. Ericsson Manufacturing Co., Ltd.
Turbines and electrical plant.—British Thomson-Houston Co., Ltd.
Copper wire, &c.—F. Smith & Co., Ltd.

Lancaster.—Electricity Committee. Accepted:—

M.P. distribution cable.—British Insulated & Helsby Cables, Ltd.

London.—LONDON, MIDLAND & SCOTTISH RAILWAY. Accepted:—

Gasfilled lamps.—Edison Swan Electric Co., Ltd.

POPLAR.—Electricity Committee. Recommended:—

Self-supporting chimney (£6003).—John Thompson & Co., Ltd.
Circulating water pipes (£3,000).—Staveley Coal & Iron Co., Ltd.
Circulating water valves (£360).—Glenfield & Kennedy, Ltd.
Screens for circulating water (£1,962).—Hick, Hargreaves, Ltd. (Barley and Jackson type).
Priary air piping (£205); breeches pipe for powdered fuel (£30); main flue (£1,196).—Vickers & International Combustion Engineering, Ltd.

HACKNEY.—Electricity Committee. Recommended:—

One 1,500-kW motor converter for Dalston Lane sub-station:—

Bruce Peebles & Co., Ltd., exact duplicate of existing machine. (Recommended.)	**£5,908**
(Alternative)	5,516
General Electric Co., Ltd.	6,057
(Alternative)	5,599
British Thomson-Houston Co., Ltd.	5,516

The Committee considers that, in view of the fact that this is the last machine which can be placed in the Dalston Lane buildings, it should be an exact duplicate of the existing 1,500-kW machine, in order that all parts may be interchangeable, and, as Messrs. Bruce Peebles and Co. submit the lowest quotation, it is of opinion that their tender should be accepted.

LONDON COUNTY COUNCIL.—Fire Brigade Committee. Accepted:—

Motor generators for charging accumulators at fire stations (£190).—Cutting Bros., Ltd.

Perth.—Electricity Committee. Accepted:—

Extensions at the Corporation electricity works (£24,000), including new boilers, turbo-generators, &c.—W. H. Allen, Sons & Co., Ltd.

South Africa.—JOHANNESBURG.—A contract for a Ward Leonard winding engine set, believed to be the second largest winding engine in the world as to peak load and the largest from a plant point of view owing to the low speed of the winding motors, has been received by Metropolitan-Vickers Electrical Co., Ltd., for the Crown Mines, Ltd.

Swansea.—Town Council. Accepted:—

Steelwork in connection with reconstruction of boilers (£1,190).—Rees and Kirby, Ltd.
Removal and reconstruction of two Stirling boilers at the electricity station (£12,978).—Stirling Boiler Co., Ltd.

Southend-on-Sea.—Town Council. Accepted:—

Five gear wheels, and 2 cylinder heads as spares, for the four 1,200-h.p. Diesel engines (£167).—Hick-Diesel Oil Engines, Ltd.

Electric Haulage in Collieries.—Tests are about to be made with an electric storage battery locomotive for haulage purposes in coal mines. Mr. Charles Markham, of Chesterfield, some time ago offered a prize of £1,000 for a locomotive of this nature, and the tests will be made on a piece of land near Brodsworth Colliery, a track, with the curves and gradients found in most pits, having been laid.

Forthcoming Events.

Society of Engineers.—Monday, February 2nd. At Burlington House, W. At 5.30 p.m. Presidential address by Mr. A. S. Buckle and presentation of premiums.

Royal Society of Arts.—Monday, February 2nd. At John Street, Adelphi, W.C. At 8 p.m. Cantor Lecture, "Radiological Research," by Mr. V. E. Pullen. (Lecture III.)

Wednesday, February 4th. At 8 p.m. Trueman Wood Lecture, "The Stability of Atoms," by Sir Ernest Rutherford, F.R.S.

Bradford Engineering Society.—Monday, February 2nd. At the Technical College, Bradford. At 7.30 p.m. Paper on "The Ultimate Position of the Single-phase Motor in Electric Power Distribution," by Mr. W. A. Benger.

Roentgen Society.—Tuesday, February 3rd. At 32, Welbeck Street, W. At 8.15 p.m. Ordinary meeting.

Electrical Society of Glasgow.—Tuesday, February 3rd. At 30, Gordon Street, Glasgow. At 7.30 p.m. Paper on "The Electrical Industry and the E.D.A.—Recent Work and Immediate Possibilities," by Mr. J. W. Beauchamp.

Institution of Electrical Engineers.—Thursday, February 5th. At the Institution, Savoy Place, W.C. At 6 p.m. Sixteenth Kelvin Lecture, "Electrical Forces and Quanta," by Dr. J. H. Jeans, F.R.S.

(INFORMAL MEETING).—Monday, February 2nd. At 7 p.m. Further discussion on the I.E.E. wiring regulations.

(Wireless Section).—Wednesday, February 4th. At the Institution, Savoy Place, W.C.2. Paper on "The Optimum Damping in the Auditive Reception of Wireless Telegraph Signals," by Mr. L. B. Turner and Mr. F. P. Best.

(North-Western Centre).—Tuesday, February 3rd. At the Engineers' Club, Manchester. At 7 p.m. Discussion on "Justifiable Small Power Plant," to be introduced by Mr. A. B. Mallinson.

(Western Centre).—Monday, February 2nd. At Plymouth. At 6 p.m. Paper on "Electric Passenger Lifts," by Mr. H. Marryat.

(North-Midlands Students' Section).—Tuesday, February 3rd. At Leeds University. At 7 p.m. Paper on "Boiler Corrosion and Feed-water Treatment," by Mr. P. Austin.

Royal Institution of Great Britain.—Thursday, February 5th. At 21, Albemarle Street, W. At 5.15 p.m. Lecture on "Properties and Structure of Quartz," by Prof. Sir Wm. Bragg, F.R.S.

Electrical Power Engineers' Association (Southern Division).—Friday, February 6th. At the Institution of Electrical Engineers, Victoria Embankment, W.C. At 7 p.m. Lecture on "Super-Tension Cable Dielectrics," by Mr. A. I. Tracey.

Junior Institution of Engineers.—Friday, February 6th. At 39, Victoria Street, S.W. At 7.30 p.m. Lecturette on "The Measurement of Hardness and Allied Properties of Metals," by Mr. E. G. Herbert.

Salford Technical and Engineering Association.—Saturday, February 7th. At the Royal Technical College. At 7 p.m. Paper on "Domestic Electricity," by Mr. A. E. Jepson.

Association of Mining Electrical Engineers.—Saturday, February 7th. At the South Wales Institute of Engineers, Cardiff. At 6 p.m. Paper on "Correction of Power Factor," by Mr. R. G. Isaacs.

The "Electrical Review" Service Department.

INQUIRIES must be accompanied by a stamped addressed envelope.

We should be glad to learn the names of makers or suppliers of:—

Glass separators for accumulators.

Glass vent plugs for use with rubber corks, also for small accumulators.

Notes.

St. Paul's Cathedral Appeal.—FURTHER RESPONSE BY ELECTRICAL COMPANIES AND OTHERS.—The following have appeared in the list of contributions received by *The Times* for the St. Paul's Cathedral Preservation Fund since our last issue went to press. The response has been magnificent, the desire of electrical interests to have a share in so worthy an effort being particularly marked. If the matter makes a more direct appeal to the ELECTRICAL REVIEW than it does to some, it is because this journal was born beneath the shadow of the Cathedral, and during the whole of its 53 years has been edited and has gone to press to the accompaniment of the pealing of its bells:—

	£	s.	d.
County of London Electric Supply Co., Ltd.	262	10	0
Power Securities Corporation, Ltd., and Messrs. Balfour, Beatty & Co., Ltd. ...	105	0	0
Waygood-Otis, Ltd.	105	0	0
Western Electric Co., Ltd.	105	0	0
Brompton & Kensington Electricity Supply Co., Ltd.	105	0	0
Chelsea Electricity Supply Co., Ltd. ...	105	0	0
Victoria Falls & Transvaal Power Co., Ltd.	105	0	0
Johnson & Phillips, Ltd.	105	0	0
India-Rubber, Gutta-Percha & Telegraph Works Co., Ltd.	100	0	0
Chance Bros. & Co., Ltd.	26	5	0
ELECTRICAL REVIEW, Ltd.	25	0	0
The Office Staff of the British Broadcasting Co.	4	4	0
Lucas & Pyke	3	3	0
Fernand Espir	2	2	0
Office and Laboratory Staff, Weston Electrical Instrument Co., Ltd.	1	3	6

New York Electrical Museum.—As a token of recognition for his work, electricians in New York intend to construct a 20-storey building in honour of Mr. Thomas Alva Edison, says *The Times*. The building, of which Mr. Edison will be invited to lay the corner stone, will be in the centre of New York, and will have an entrance arcade with a 25-ft. bronze statue of the inventor. Besides offices it will contain a large electrical museum, in which Mr. Edison will be asked to place all his working models, and other inventors will also be asked to contribute. The announcement has been made by Mr. Charles Eidlitz, chairman of the governors of the Electrical Trade Board, which intends to make the building a great electrical centre.

L.C.C. Loans for Electrical Development.—The Finance Committee of the London County Council has agreed to make loans to the following authorities out of the Consolidated Loans Fund, for the purpose of extending their electrical undertakings:—Bermondsey (£19,948), Fulham (£50,000), Hackney (£39,789), Poplar (£13,500), and Woolwich (£78,345).

South African Engineers' Convention.—In connection with the convention of the South African Association of Municipal Electrical Engineers which was mentioned in our last issue, the Municipality of Durban organised an "electrical week." We have received a souvenir booklet issued for the occasion in which a number of electrical matters are dealt with in a manner likely to interest the "lay" public. An electrical and wireless exhibition was held during the week and a very representative display of apparatus was on view. The souvenir contains short articles on such matters as electric heating and cooking, broadcasting, &c., and a description and an illustration of one of the new electric trains are included.

Pulverised Fuel in the United States.—Mr. G. E. Leonard, the president of the International Combustion Engineering Corporation, of New York, and a director of Vickers and International Combustion Engineering, Ltd., who is in London, says that the progress made in American power plant design, particularly with regard to pulverised fuel firing, has been phenomenal, contracts placed in 1924 being for equipment to serve boilers having over a million square feet of heating surface. The total heating surface installed in American power stations for pulverised fuel firing is, therefore, now well over 2½ million square feet. There were many striking developments during the past year in this direction.

Edinburgh Electrical Society.—At a meeting of the Society, on January 23rd, Mr. George Herbert, of Benjamin Electric, Ltd., gave a lecture upon "Industrial Illumination." After describing the relationship between candle power, watts and lumens, the lecturer dealt with illumination from the scientific point of view, and concluded by giving his views on the future development of electrical illumination. An interesting discussion followed the lecture.

Radio Communication with Entombed Miners.—Radio communication between entombed miners and surface rescue parties has proved impracticable, the American Bureau of Mines announced in describing experiments extending over several years. The high-power equipment necessary for communication through strata of from even 1,000 to 2,000 ft., the Bureau said, would be too bulky, heavy, complicated, fragile, and delicate for practical requirements. It was stated, however, that there was some promise in the application of "line radio," which consists of transmission along metallic conductors, such as water and compressed-air pipes, power and lighting circuits, and mine car tracks.—*Reuter's Trade Service* (Washington).

Fatality.—An inquest was held at Leamington on January 22nd into the death of Edward Jackson. It was stated that a drum of electric cable, weighing nearly three tons, was being dragged along a road by a gang of men when Jackson slipped in front of it and the drum passed over his body. The Coroner questioned whether the practice revealed was a legitimate way of moving cable, but, in returning a verdict of "Accidental death," the jury made no recommendation.

Gas *and* Electricity for New Houses.—The Housing Committee of the London County Council recommends that an agreement be entered into with the Shoreditch Borough Council for the supply of electricity for lighting, cooking, and heating purposes to the dwellings which are to be erected on the County Council's Whitmore estate, Hoxton. At the same time it is recommended that the Gas Light & Coke Co. shall be allowed to equip the first block of dwellings on the estate for gas lighting, heating, and cooking, and that an agreement for the supply of gas be entered into with the company.

Appointments Vacant.—Electrical testing engineer and turbine drivers for the Barking Power Station. Engineering draughtsman (temporary) (£5) for the Urban District Council of Aberdare Electricity Department. Canvasser and attendant for electrical showroom (£175+) for the Walthamstow Corporation Electricity Works. Showroom and sales assistant for the Southport Corporation Electricity Department. Power house superintendent, for the Cheltenham Corporation electricity department; senior assistant engineers (£400-£450) and junior assistant engineers (£200-£250), for the mains construction department of the Yorkshire Electric Power Co. (See our advertisement pages to-day.)

Educational.—EAST LONDON COLLEGE (UNIVERSITY OF LONDON).—A course of six lectures on "Electrical Transients in A.C. Power Circuits" will be given by Mr. S. Austen Stigant on Mondays at 6 p.m., beginning on February 2nd. Fee for the course, 10s. 6d. For full particulars see our advertisement pages to-day.

The Need for Railway Electrification at Sydney.—Mr. W. F. Barton, chief assistant signal engineer of the New South Wales Government Railways, has emphasised the need for the electrification of the Sydney suburban railways after a close study of conditions in the United States. He says that it is possible to operate multiple-unit electric trains with a headway of 1½ minutes as against 4 minutes with steam locomotives usually. The steam trains at Sydney are handled very expeditiously, the headway being 3 minutes. In Mr. Barton's opinion nothing further can be done in the way of improving signalling; electrification is the only means of speeding-up transport.

Prize Competition.—The Institution of Heating and Ventilating Engineers offers prizes amounting to 25 gs. for three papers on subjects connected with heating and ventilating, to assistants (not principals) who are engaged in such work. Particulars may be obtained from the Secretary, 38, Victoria Street, London, S.W. The competition closes at the end of March.

National Council of Technical Staff Associations.—A meeting was held under the auspices of the above Council, in Manchester, on January 15th. Mr. J. F. Heslop, chairman of the Council, presided, and there was a good attendance of engineers from the supply and manufacturing industries, as well as a small sprinkling of chemists. In his introductory remarks the chairman stated that if the Council was to realise its objects it was essential that there should be co-operation throughout the length and breadth of the country, and he therefore looked for every engineer to give up his individual outlook and to recognise his liabilities and responsibilities to his fellows. He also emphasised the desirability of developing the "team spirit" amongst engineers and scientific workers.

Mr. H. J. Ping traced the growth of the various sectional organisations for technicians, such as the E.P.E.A. and the I.E., and Mr. A. L. Lunn described the evolution of the policy of the E.P.E.A. Mr. R. Hazleton, secretary of the I.E., touched on the good work which had already been accomplished by the National Council, and Mr. J. W. Thomas described the recent progress made on the National Joint Board in connection with a scheme for training engineers for the electricity supply industry.

A Large Mine Winder.—A contract has been received by the Metropolitan-Vickers Electrical Co., Ltd., for a Ward-Leonard electrically-driven winding engine for the Crown Mines, Johannesburg, S.A. It is believed that this will be the second largest winding engine in the world so far as peak load is concerned, and the largest from a plant point of view owing to the low speed of the winding motors, namely, 37.2 r.p.m. The two winding motors will have a normal peak rating of 5,930 h.p., and will be capable of dealing with a maximum peak load of 8,000 h.p. The Ward-Leonard set will consist of one 2,000-volt, 3-phase, 50-cycle induction motor coupled direct to two d.c. generators of corresponding capacity, operating at 485 r.p.m. with directly coupled exciter. The winding drum will be of the cylindro-conical type, having a small diameter of 15 ft. rising to 30 ft., and will probably be the biggest drum in the world. The duty of the winding engine will be to raise a net load of 7.5 short tons from a vertical depth of 3,112 ft. at a maximum winding speed of 54 ft. per second. The sub-contractors for the mechanical parts were Messrs. Fullerton, Hodgart & Barclay, Ltd., of Paisley.

The Metropolitan-Vickers Co. has installed a total of no fewer than 131 electric mine winders in this country, South Africa, India, Spain, and Belgium. The plant aggregates 121,817 maximum brake horse-power, the root-mean-square h.p. of the individual motors ranging from a maximum of 2,400 b.h.p. to an average per motor for all installations of 930 b.h.p.

The Harworth Colliery Winder.—CORRECTION.—We regret that in the note on this subject in our last issue (p. 143) it was stated that steam engines, in conjunction with mixed-pressure turbines, were employed, whereas the system installed, the Metropolitan-Vickers "Stubbs-Perry" system, does not make use of this arrangement. In a letter the Metropolitan-Vickers Electrical Co., Ltd., states:—

"The outstanding feature of the Metropolitan-Vickers S.P. system, consisting as it does of the replacing of the ordinary fly-wheel motor of the flywheel equalising set by a high-speed, high-pressure condensing turbine, is the high overall thermal efficiency obtained. In a new scheme the transfer of heat from one prime mover to another in the form of steam is demonstrably less efficient, and it is not our practice to employ mixed-pressure turbines in this capacity. No doubt there are occasions when a compromise of this nature may be economically justified for general power supply purposes."

We understand that the mechanical parts of this winder are to be built at the Barrow-in-Furness works of Messrs. Vickers, Ltd., and that a complete duplicate plant has been ordered by the same colliery company.

Oxidation of Aerial Wires.—Mr. L. B. Turner, M.A., M.I.E.E., explains in the January *Proceedings* of the I.E.E. that measurements made on thick solid and stranded wires to ascertain the effect on their high-frequency resistance of the oxide film formed by weathering, show that weathering produces no sensible effect, under either dry or wet conditions. He compares the several methods of measuring h.f. resistance in respect of their suitability for determining the resistance of stout straight conductors, and concludes that some bridge arrangement, such as that used by Kennelly and Affel, seems to be much the more suitable. They were able to measure low resistance, such as 0.2 ohm, with an uncertainty of only one-third of 1 per cent.

Institution Notes.

Institution of Electrical Engineers.—FARADAY MEDAL.—The Council of the Institution has made the fourth award of the Faraday Medal to Sir J. J. Thomson, M.A., O.M., F.R.S., an honorary member of the Institution, and Master of Trinity College, Cambridge. The Faraday Medal is awarded not more frequently than once a year, either for notable scientific or industrial achievement in electrical engineering, or for conspicuous service rendered to the advancement of electrical science without restriction as regards nationality, country of residence, or membership of the Institution. Sir Joseph Thomson's publication in 1897 of his discovery of the existence of electrons and their emission from hot bodies was one of the fundamental stages in making possible the realisation of radio telegraphy.

PRESENTATION.—At the meeting of the Institution on January 22nd the President, Mr. W. B. Woodhouse, announced that there was present that evening a deputation from the Institution of Gas Engineers, whose object would be explained by the President of the I.G.E. Mr. J. F. Bell then said they had come to ask the acceptance of a framed certificate as a mark of their desire to acknowledge the kindness of the I.E.E. in allowing its building to be used by the Gas Engineers. He hoped the happy feeling of friendliness between the two Institutions would long continue, and wished the I.E.E. prosperity, as there was room for both. He felt that the gas industry would not have made the advance it had done had it not been urged forward by electrical engineers. Mr. Woodhouse then received the engraved plate on behalf of the I.E.E. Council, and Dr. A. Russell accepted the certificate as a record of his presidency of the I.E.E.

INFORMAL MEETING.—An additional informal meeting will be held at the Institution on Monday, February 2nd, at 7 p.m., for a further discussion on the I.E.E. wiring regulations.

NORTH-WESTERN STUDENTS' SECTION.—The paper announced for February 24th, entitled "E.h.p. Switching Practice," will be read on February 28th, at the Manchester College of Technology.

MERSEY AND NORTH WALES (LIVERPOOL) CENTRE.—As many as 800 tickets were issued by the Centre for a lecture by Sir Oliver Lodge on January 19th. The lecture, "The Nature of Electricity," was held at the Arts Theatre of the Liverpool University, where Sir Oliver was for nearly 20 years Professor of Physics. Sir Oliver dealt extensively with the atomic theory of matter and the ether, and drew a fascinating picture of the "astronomy of the atom," each "star" of the atom being a unit of electricity. The atoms and the planets were common in that they were both held together by the ether, the unifier of the universe. His notion of ether was that it must be denser even than platinum or gold, and therefore than electrons. Its electricity was awful, and the strain on it in holding all the worlds together was terrific. Mr. H. H. Harrison, M.I.E.E., in introducing Sir Oliver, referred to his election last year as an honorary member of the Institution of Electrical Engineers.

KELVIN LECTURE.—On Thursday, February 5th, the 16th Kelvin Lecture, on "Electrical Forces and Quanta," will be delivered by Mr. J. H. Jeans, M.A., D.Sc., LL.D., F.R.S., secretary of the Royal Society. At the beginning of the meeting a statuette of the late Sir Joseph Wilson Swan, D.Sc., F.R.S., will be presented to the Institution by Mr. R. K. Morcom, C.B.E.

Institute of Metals.—ANNUAL MEETING.—The annual general meeting of the Institute will be held at the Institution of Mechanical Engineers on March 11th and 12th, commencing each day at 10 a.m. Twelve communications are due for presentation at the meeting. The annual dinner will take place at the Trocadero Restaurant on March 11th, at 7 p.m., and ladies will be present.

Radio Society of Great Britain.—PRESIDENTIAL ADDRESS.—Sir Oliver Lodge, in the course of his presidential address to the above-named Society, explained, according to *The Times*, that radiation was purely a phenomenon of the ether. The only link between them was electricity and magnetism; but there must be both electric and magnetic fields superposed at right angles to each other to produce radiation, travelling

with the velocity of light, at right angles to both. Atoms, when jostled, not only emitted radiation; they emitted electrons. There was something in the retina of the human eye which responded in this way, flinging away electrons at characteristic speed when it felt luminous tremors, and it was to that emission that vision was due. He doubted if the electric tremors affected the nerves directly; they stimulated something specially adapted to respond to the vibrations. What stimulated the nerves was the shock of the electrons ejected by the atoms, which struck them with the speed of some thousand miles a second. "This is the Theory of Vision," the speaker remarked, "which is in process of being born, and which, I feel sure, contains the clue that has to be worked out by physicists and physiologists in combination. The eye is like a receiving instrument for detecting radio waves of extremely short and definite length. Vision is a photo-electric phenomenon. I make that rash statement, and say that the burden of proof, and especially the burden of disproof, rests upon future experimenters."

Our Personal Column.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the* ELECTRICAL REVIEW *posted as to their movements.

Mr. F. T. BILLINGSLEY has been appointed to the post of assistant electrical engineer on the Gold Coast Government Railways, and is shortly leaving to take up that position. From 1920 to 1924 he was assistant engineer to the Burma Electric Tramways & Lighting Co., Ltd., Mandalay, Burma.

A correspondent states that Mr. A. PAGE, who has been in the employment of the Dundee Corporation Electricity Department, and has carried out important duties at Carolina Port generating station, has secured an important appointment with Messrs. Escher Wyss & Cie., Zurich. It is expected that he will return to this country as the engineering manager for the company in Great Britain.

Mr. E. A. BARKER, borough electrical engineer at Barnsley, on completing 25 years' service with the Corporation, has been presented by the staff and employés of the Electricity and Public Lighting Department with a cabinet of cutlery.

Hammersmith Corporation Establishment Committee recommends that Mr. W. WARREN, fourth engineer-in-charge, be promoted to the position of repairs engineer, at a salary of £412 per annum.

Mr. R. F. SCHUCHARDT, chief electrical engineer to the Commonwealth Edison Co., has been nominated as the next president of the American Institute of Electrical Engineers. Another nomination, already made public, says the *Electrical World*, is that of Mr. C. E. SKINNER, assistant director of engineering with the Westinghouse Electric & Manufacturing Company. A third nomination put forward is that of Mr. L. T. ROBINSON, engineer-in-charge of the Laboratory of the General Electric Co. at Schenectady.

The marriage took place at Mansfield, on January 10th, of Mr. HARRY TOPLEY, A.M.I.E.E., of Doncaster, and Miss ADA MARION EVANS, of Mansfield.

On his retirement from the position of Contract Officer, Post Office Telephones, Chichester, after 20 years' association with the district, the colleagues of Mr. S. G. ARCHBOLD presented him with a gold watch at the Contract Office, Post Office Telephones, Brighton, on January 22nd. The presentation was made by Mr. F. W. Taylor, District Manager, Brighton.

The Luton Town Council has appointed Mr. R. H. NUTTALL, rolling stock superintendent of the Doncaster Corporation Tramways, as tramway engineer and manager in succession to Mr. W. W. Clarke. There were 45 applicants for the position.

Mr. A. J. THORNELOE, A.M.I.Mech.E., has resigned his position of sales manager to the G. Cohen & Armstrong Disposal Corporation, and communications should be addressed to him at his private address, "Northbank," Kellfield Avenue, Lowfell, Gateshead-on-Tyne.

Major H. LEFROY has been appointed a director of Marconi's Wireless Telegraph Co., Ltd.

Mr. E. H. FARRAND, sectional engineer at the Leeds Post Office, who was actively engaged in connection with the installation of the automatic telephone service at Leeds, has retired.

Mr. HERBERT G. WHITE, A.M.I.E.E., A.M.I.R.E., &c., who has been associated for the past 14 years with Messrs. Gent and Co., Ltd., has relinquished his post as London manager with this firm to take up the appointment of chief engineer of the wireless department of Messrs. C. A. Vandervell & Co., Ltd., of Acton.

Mr. J. C. WHITELEY, manager during the past 10 years of South Shields Corporation tramways, has been appointed manager of the Grimsby Corporation system. Mr. Whiteley went to South Shields from the Chatham and District Light Railways.

Obituary.—SIR G. L. MOLESWORTH.—We regret to record that Sir Guilford Lindsey Molesworth, the celebrated railway engineer, and author of the famous "Pocket Book of Engineering Formulæ," which first appeared in 1862 and went through many editions, passed away at Bexley on January 21st, at the age of 96 years.

MR. W. FELGATE.—The death occurred suddenly, on January 15th, at the age of 77 years, of Mr. William Felgate, who was for many years a partner in the firm of Gough & Felgate, electrical engineers, of Burton-on-Trent.

HERR M. SCHORCH.—The death is announced from Weimar, at the age of 72 years, of Herr Max Schorch, head of the electrical apparatus manufacturing business of Max Schorch and Cie., of Rheydt, Germany.

Will.—The late Mr. J. M. MCELROY, for many years Corporation tramway manager at Manchester, left £2,52[illegible] net and £2,723 gross personalty.

New Companies Registered.

Willans (Consultants), Ltd. (203,301).—Private company. Registered January 22nd. Capital, £100 in 1s. shares. To carry on the business of radio and general engineers and consultants, &c. The permanent directors are:—P. W. Willans, The Cottage, Pattishall, Towcester, Northants; G. R. S. Willans, 6, High Park Road, Kew, Surrey. Qualification, 1 share. Remuneration as fixed by the company. Solicitors: Yarde and Leader, 1, Raymond Buildings, Gray's Inn, W.C. Registered office: Hazlitt House, Southampton Buildings, Holborn, W.C.

Eddystone Components, Ltd. (203,218).—Private company. Registered January 19th. Capital, £1,000 in £1 shares. To acquire the business of a manufacturer of and dealer in electrical fixtures and fittings carried on by A. Bird as "The Eddystone Lamp Co." at 13, Mincing Lane, Blackburn, and to carry on the business of electrical engineers, manufacturers of and dealers in all kinds of electrical fixtures and fittings, wireless engineers and manufacturers of or dealers in wireless apparatus, &c. The first directors are:—A. Bird (permanent), 13, Mincing Lane, Blackburn; Mrs. L. E. Bird, 13, Mincing Lane, Blackburn. Qualification, 10 shares. Secretary: A. Bird. Registered office: 13, Mincing Lane, Blackburn, Lancs.

Playford & Son, Ltd. (203,301).—Private company. Registered January 22nd. Capital, £500 in £1 shares. To carry on the business of electrical, mechanical, civil and constructional engineers, contractors and agents for the manufacture, supply, and installation of electrical, mechanical, constructional, heating and hydraulic plant and machinery, manufacturers of and dealers in automobiles and automobile parts, steam boilers and gas plants, haulage contractors, &c. The first directors are:—Mrs. Laura K. Playford, Aston House, High Street, Newmarket; F. C. S. Playford, Aston House, High Street, Newmarket; H. R. Scott, 1, Mackenzie Road, Cambridge; C. W. Clark, 45, de Freville Avenue, Cambridge. Qualification, 5 shares. Secretary: K. E. Playford. Registered office: Aston House, High Street, Newmarket.

Philips Lamps, Ltd. (203,325).—Registered as a private company on January 23rd with a nominal capital of £50,000 in £1 shares. The objects are: To carry on the business of electricians, manufacturers and sellers of, agents for and dealers in all kinds of electric lamps, including gasfilled, vacuum, carbon and arc lamps, all kinds of radio apparatus, electric discharge tubes and other articles and instruments, wires for radio signalling, medical and other purposes, &c. The subscribers (each with one share) are:—H. W. Bergen, Keekeeklaau, Eindhoven, Holland, secretary of company; W. C. L. van Eidenhuit (?), Oesleinde 235, Voorburg, manager of company. The first directors are to be such persons as may be nominated by Naamlooze Vennootschap Philips Gloeilampenfabricken, of Eindhoven, Holland. Qualification, £1. Remuneration as fixed by the company. Secretary (*pro. tem.*): W. C. L. van Eidenhuit (?). Solicitors: Coward, Chance and Co., 30, Mincing Lane, E.C.

L.P.S. Electrical Company, Ltd. (203,320).—Private company. Registered January 23rd. Capital, £5,000 in £1 shares. To carry on the business of electrical engineers, manufacturers and importers of and dealers in insulated cables and wires, tungsten and molybdenum products, insulated sleevings and all other kinds of insulating materials, electrical accessories, and machinery and appliances, including motors, dynamos, magnetos, telephones, instruments, &c. The subscribers (each with one share) are:—H. S. Sheffield, 448, Strand, W.C.2, clerk; S. B. Edwards, 448, Strand, W.C.2, clerk. The first directors are:—J. Lerman (governing director and chairman) and Mrs. D. Lerman. Qualification, £1,000. Secretary: H. S. Sheffield.

Young, Osmond & Young, Ltd. (203,249).—Private company. Registered January 20th. Capital, £5,000 in £1 shares. To carry on the business of electrical, agricultural, mechanical, hydraulic, domestic, heating, ventilating and general engineers, founders, smiths, electricians, workers of and dealers in electricity, motive power and light, manufacturers of and dealers in machinery, automobiles, &c. The first directors are:—J. M. Young, Horsielands Farm, Newdigate, Surrey, farmer; E. M. Young, Horsielands Farm, Newdigate, Surrey, mechanical engineer; C. B. Osmond, Clifton, Blackheath Park, S.E.3, electrical engineer (each of whom may retain office for five years, and shall be called an "original" director). Qualification, "original" directors, 10 ordinary shares; of ordinary directors, £5. Remuneration of "original" directors, £900 per annum; of ordinary directors as fixed by the company. Secretary: J. M. Young. Solicitors: G. F. Hudson, Matthews, Goodman and Co., 32, Queen Victoria Street, E.C.3. Registered office: Stafford House, Norfolk Street, Strand, W.C.2.

Watmel Wireless Co., Ltd. (203,212).—Private company. Registered January 17th. Capital, £2,000 in £1 shares (1,000 "A" and 1,000 "B"). To acquire the business of manufacturers of, and dealers in, instruments, appliances, apparatus, devices and machinery required for or capable of being used in connection with radio, wireless, telegraphic or telephonic systems, or any combination thereof; and the transmission, recording, and reproduction of telegraphic or telephonic messages, pictures, or otherwise carried on by A. E. Watkins and C. D. Melhuish as the Watmel Wireless Co. at 332a, Goswell Road, E.C., and elsewhere, together with the name "Watmel." The permanent directors are:—A. E. Watkins, 134, Oliver Road, Cricklewood, N.W.2, electrical engineer (chairman); C. D. Melhuish, 53, Highbury Park, N., electrical instrument maker. Remuneration, as fixed by the company. Solicitors: S. Langford & Redfern, 5-6, Clement's Inn, W.C.2.

R.M.A.S., Ltd. (203,072).—Private company. Registered January 13th. Capital, £30,000 in £1 shares. To carry on the business of manufacturers of magneto spare parts, magnetos, and ignition apparatus, electrical and mechanical engineers, founders, smiths, machinists, motor repairers, manufacturers and workers of, and dealers in and agents for electrical, magnetic, telegraphic, telephonic, wireless, and other electrical appliances and apparatus, &c. The first directors are:—F. Forrester, "Ballochmyle," Merrilocks Road, Blundellsands, Liverpool, engineer; E. R. Radcliffe, 26, Willows Avenue, Lytham, engineer; J. Myles, 13, Lichfield Drive, Sedgley Park, Manchester, accountant. Qualification, £500. Solicitors: L. Fraser, 17, Market Street, Manchester. Registered office: Ashburton Road, Old Trafford, Manchester.

Official Returns of Electrical Companies.

Radio Clubs, Ltd.—Mortgage dated January 6th, 1925, to secure £1,000 and any other moneys that may become due, charged on certain properties in Elswick, Newcastle-on-Tyne. Holders: Newcastle-upon-Tyne Permanent Building Society.

Orford Electric Light and Power Co., Ltd.—Issue on December 30th, 1924, of £100 debentures, part of a series already registered.

Sunderland District Electric Tramways, Ltd.—Trust deed dated December 29th, 1924 (supplemental to trust deed dated December 8th, 1903, securing £160,000 first mortgage debentures of which £120,000 is outstanding, charged on certain land in Newbottle, Durham, except mines, &c. Trustees: Debenture Securities Investment Co., Ltd., 19-21, Moorgate, E.C.2.

Todman, Ryall & Co., Ltd.—Satisfaction in full on January 7th, 1925, of second mortgage debentures dated April 28th, 1923, securing £1,000. Particulars filed on January 17th, 1925, of £10,000 debentures and a premium varying as to the date of redemption, authorised October 28th, 1924, charged on the company's undertaking and property, present and future, including uncalled capital (ranking, *pari passu*, as a second charge thereon, and next after such of the £750 first mortgage debentures as shall for the time being be outstanding), the amount of the present issue being £5,000.

Eastern Extension, Australasia & China Telegraph Co., Ltd. (7,224).—Return dated July 10th, 1924. Capital, £4,000,000 in £10 shares. All shares taken up. £4,000,000 paid. Mortgages and charges, £752,400.

Refty Electrical Appliances, Ltd.—W. E. Fisher, of 12, Old Square, Lincoln's Inn, W.C.2, was appointed receiver on January 8th, 1925, under powers contained in debenture dated August 26th, 1924.

Park Royal Engineering Works, Ltd. (old company).—J. Davie, of 3, London Wall Buildings, E.C., ceased to act as receiver or manager on December 31st, 1924.

Venner Time Switches, Ltd.—The satisfaction (£2,450 on December 1st, 1924) of debentures mentioned in this column last week completes the repayment of £5,000, the balance of £2,550 having been paid off in previous years, as announced in our pages from time to time between July, 1912, and December, 1924.

City Notes.

East London Railway Co.

The report for the year ended December 31st, 1924, records a gross revenue of £89,107. The directors have asked for the question of the amount of rental to be paid by the lessees to be submitted to arbitration, as agreement could not be reached. The board recommends the acceptance of the Southern Railway Company's offer, as it considers the terms advantageous to the stock-holders. A conditional agreement has been entered into and will be submitted to an extraordinary meeting on February 17th. The ordinary meeting was to be held yesterday (Thursday).

Chatham and District Light Railways Co.

The revenue for the past year was £76,265 and the expenditure £55,339, leaving a net revenue of £19,926. After deducting rents, &c., and adding interest receivable, there was a balance of £12,308. It is proposed to pay a final dividend of 4½ per cent. on the ordinary shares (making 7 per cent. for the year), and to carry forward £1,888 subject to additional remuneration to directors. During the year the directors purchased and cancelled £67,600 of preference shares at a cost of £50,477, reducing the outstanding preference capital to £50,000. The profit on this transaction and from investments, amounting to £22,108, has been reserved for depreciation. The meeting was to be held yesterday (Thursday).

Ferguson, Pailin, Ltd.

At the annual general meeting, held on January 22nd, at the offices at Higher Openshaw, Manchester, Sir Kenneth Crossley, Bart., who presided, said that there was much reason for satisfaction in the progress made by the company during its short existence. To commence in an insignificant way, and in a little more than ten years to be recognised as one of the leading manufacturers of electrical switchgear in the country, was no small achievement. In the past year progress had been well maintained and the indications of an improvement which were mentioned at the last meeting had to some extent materialised. They had made large additions to the paid-up capital but the profit earned had more than kept pace and the directors felt no hesitation in recommending a larger dividend, adding another three per cent. on to the dividend paid last year on the preference shares, making it 13 per cent., and one per cent. on the ordinary, making 8 per cent. In view of the increase in the issued capital, they had allocated a larger amount to reserve than formerly (£5,000 instead of £2,000) making a total reserve account of £15,000. The balance carried forward was £25,104, which was subject to taxation for last year only. The premium received on the ordinary shares issued during the year amounted to £3,343 and this was sufficient to pay the whole of the expenses of the recent issue and leave a balance of £1,128, which had been disposed of by reducing the book value of goodwill and patents. The public did not respond too well to their offer of share capital last year. Probably the unsettled amount of the liability to the revenue authorities caused some misgiving. The amount of that liability had been definitely agreed upon with the authorities and the total being well below the amount shown in the prospectus, that uncertainty had disappeared. They would require more capital shortly for various needs, among which was a large extension to the Openshaw factories. A considerable balance of shares was still available and in all probability these shares would be offered in the near future. It became known some time ago that a large extension would have to be made to the works. The congestion in the existing buildings had become so acute that it seriously hampered productive capacity and they had been compelled to rent storage accommodation elsewhere. They had consequently decided to go ahead with the extensions which would be completed and occupied in stages. The possibility of having to erect further extensions in future years had also been discussed and they thought it desirable to purchase the freehold of a large plot of vacant land adjoining the existing plot. A portion of the area would be covered by the extensions which they were now proceeding to erect. The current year appeared to promise well. Lately the reserve orders had tended to increase and there seemed a likelihood of a number of electricity schemes being proceeded with. The more they were investigated, the more they would gain in importance and possibilities. These developments were among several indications that the economic life of the country was recovering and that once more faith could be placed in the future. The cumulative effect was distinctly encouraging and it was possible that the unparalleled demand for electrical apparatus which was confidently expected would arrive before long. Their policy was to be prepared for that demand rather than wait until it was upon them.

Mr. S. Ferguson said that the industry had a great future open to it. Unfortunately, one change had taken place in the past year. Swiss electrical workmen had gone back to the 52-hour week and this placed the Swiss manufacturer in a better position. Relations with their own workmen were peaceful, although there had been a small sectional strike during the past year. This had been settled, however, and they had now received an application for an advance in wages by the workmen. During the past year they had more than held their own.

Traction and Power Securities, Ltd.

After deducting expenses, the net revenue for the past year was £43,820. To this is added £14,655 brought forward, making £58,475. Interim dividends absorbed £16,217 and it is now proposed to pay final dividends of 2½ per cent. on the preference stock and 7 per cent. on the ordinary stock (interim 2½ and 4 per cent. respectively). The surplus from sales of investments amounted to £196,700, and after deducting discount and expenses a balance of £162,986 is transferred to reserve. The meeting is to be held on February 2nd.

French Company.

Société d'Electricité de Paris.—The year's working of this company resulted in a net profit of 7,130,571 fr., from which dividends of 50 fr. per share and 133.33 fr. *per part beneficiaire* were sanctioned. The report recorded a steady increase in the supply of energy from the St. Denis station, rising from 190,228,020 kWh in 1922-23 to 209,937,254 kWh in 1923-24. During the year the company had revised its contract with the Chemin de Fer Métropolitain de Paris, but this would only become operative from the end of the current working year. It involved a lower price per kWh, but as compensation a further supply of current to the railway was agreed to, equivalent to that formerly supplied by the Bercy works belonging to the railway, which had now ceased working.

Yorkshire (West Riding) Electric Tramways Co., Ltd.—The gross earnings during the past year amounted to £161,265—an increase of £3,456. After meeting the working expenses and debenture interest there was a net profit of £47,135 and to this is added £360 brought forward, making £47,495. It is proposed to transfer £20,581 to reserve, renewals, and depreciation funds, and to pay a dividend of 5 per cent. on the ordinary shares, leaving £8,219 to be carried forward. The meeting is being held to-day (Friday).

Marconi's Wireless Telegraph Co., Ltd.—An interim dividend of 5 per cent., less tax, has been declared upon the ordinary shares. No interim dividend was paid last year, the final dividend being 10 per cent.

Montreal Light, Heat, and Power Co.—A dividend of $1¼ per common share is being paid in respect of the quarter ending January 31st.

Belgian Company.—In order to provide for the growing demand for energy the *Société de l'Electricité de Seraing*, of Seraing, near Liège, has decided to increase its capital from 12 to 30 million fr.

German Electrical Issues in New York.—The London financial papers stated on Monday that negotiations were nearing completion for the issuance in New York by the National City Co. of $10,000,000 German General Electric Co. 7 per cent. coupon bonds at a price to yield over 7¼ per cent. The issue is stated to be the first bond issue made by the German General Electric Co. outside Germany. A similar amount is also being raised in New York by the Siemens group in the shape of a $5,000,000 three-year loan and a five-year loan of $5,000,000, both bearing interest at 7 per cent.

Enfield Cable Works, Ltd.—An interim dividend of 5 per cent. has been declared on the ordinary shares.

Stocks and Shares.

MONDAY EVENING.

STOCK Exchange business has dwindled into a condition of quietude. In no department is there any real activity, although investment securities are well maintained in price, owing to the persistent demand from all parts of the country. The railwaymen and the coal miners are raising demands for more wages, and Labour begins to look round for suitable openings through which to thrust new claims upon trade that is already handicapped by high costs. From the Stock Exchange point of view, the result of this uneasiness is seen in mild depression amongst Home Railway prices, and a slight dulness in iron, coal and steel shares. Speculation tends to withdraw its enterprise, and investment holds the field.

It may be of interest and of service to mention an incident which reflects the financial tendency of the day. Half a dozen sound preference shares were picked out, after close examination, as worth being mentioned here for the attention of those readers to whom this particular form of suggestion proves useful. To advise the purchase of shares that cannot be obtained is, of course, as useless as it is exasperating; such counsel can be safely left to the professional journalist. In selecting six different shares, it was a *sine qua non* that they should be obtainable to the extent of a few thousands in each case. Before the end of the day—Monday in this week—out of the six examples chosen, three were rendered valueless for our purpose because all the shares, on offer earlier, had been taken, and these were the most tempting of the sextet selected.

There remain on offer, at the time of writing, a few hundred 6 per cent. preference shares of North Metropolitan Electric, at 23s. 3d., April and October dividend, giving a yield of £5 3s. per cent. on the money; County of London 6 per cent. preference at 24s. 3d., March and September, paying just under 5 per cent., and Clyde Valley Sixes, May and November, at 23s., offering £5 4s. 6d. per cent. to the investor. The dividend service on all of these was thoroughly well covered according to the last-published figures. Llanelly and District Electric 6 per cent. preference are obtainable, in fair quantity, at 19s. 9d. ex dividend, the security being good, but the title somewhat unfamiliar to the ears of investors who do not know the locality. General Electric 7½ per cent. "B" preference, at 24s., paying in June and December, offer 6¼ per cent. On the last year's profits, the dividend on these shares was covered more than thrice, and the next report is likely to show a still higher proportion of safety for the purchaser.

On the week, Charing Cross ordinary stand 9d. higher at 47s., and Kensingtons have further spurted to 11¼. Modest demand for South Londons had a sharp effect upon the price, which rose 3s. 9d. to 48s. 9d. Westminsters improved to 11 7/16; Londons to 35s. 6d. Edmundsons regained the dividend deduction. Lancashires are 1s. up, at 26s., and with buyers about at the price. Lanarkshires met with inquiry from the North, at 17s. The market as a whole exhibits decided strength. Bournemouths yielded a little ground, and City Lights shed sixpence of their previous gain.

Home Railway stocks are dull on the talk of the N.U.R. president, with its hint of a revival of the Triple Alliance. Metropolitans have receded to 80; Districts to 55½. The Metropolitan dividend will be declared at the end of this week, and hopefulness looks for 4½ per cent., as against the 4 per cent. paid in 1923. Underground "A" drooped to 10s. The Income bonds remain steady at 101, and the Income debenture stock has strengthened to 105.

"Dollar" securities are disposed to give way, as the American exchange now stands so close to the normal, pre-war rate. Enhancement of the sterling rate reduces the value of dividends paid in dollars. On the other hand, the freedom of market that would be restored to dollar stocks, by the re-establishment of active business between the London and New York Stock Exchanges, might counteract the effect of the former consideration. The movement is being watched with keen interest: great is the discussion as to whether the present time is ripe for an immediate return to the gold standard.

Cable stocks and shares have little of fresh interest to show in their lists. Marconis developed a little liveliness, upon declaration of a 5 per cent. interim dividend, the announcement coming as rather an agreeable surprise. The price of the shares rose to 35s. Other members of the group are steady. Cable manufacturing shares have gone back after their rapid rises. British Insulated, Callender's and Henley's now stand at the common level of £3. Enfield Cable Works has declared a 5 per cent. interim dividend on the ordinary shares, against nil a year ago. This strengthens the opinion previously expressed that the 7½ per cent. preference make a sound investment and it justifies the steady advance that has taken the price to 24s.

Anglo-Argentine Tramways preferences have both improved. There is a firmer tendency amongst Mexican Utilities, thanks to the speech of the Mexican President in which he optimistically foresaw a possible balancing of the country's Budget. In engineering shares, Babcocks are better at 55s. 9d. The new Armstrong 6½ per cent. third debenture, issued at 99½, strengthened to ¼ discount.

Rubber shares, attracting more academic attention than public business, are better in tone. Resumption of the rise in the price of rubber is expected after February 1st, and the standard of production has been fixed for the succeeding three months.

Share List of Electrical Companies.

	Nom.	Dividend. 1922.	Dividend. 1923.	Price Jan. 26. 1924.	Rise or fall.	Yield. p.c.
HOME ELECTRICITY COMPANIES.						
Bournemouth and Poole	£1	10	13	2⅝	— 1/16	5 1 4
Brompton Ordinary	£1	12	10	1½	—	*5 6 8
Charing Cross Ordinary	£1	14	14½	47/-	+9d.	6 3 7
do. do. do. 4½ Pref.	£1	4½	4½	17/6	—	5 2 10
Chelsea	£1	10	12	37/6	—	6 8 0
City of London	£1	15	15	49/6	—6d.	6 1 0
do. do. 6% Pref.	£1	6	6	23/6	—	5 2 2
Clyde Valley	£1	8	8	28/-	—	5 14 4
County of London	£1	10	11	53/3	—	5 14 1
do. do. 6% Pref.	£1	6	6	23/6	—	5 2 2
Edmundson's Ordinary	£1	7	7	22/-xd	+6d.	... ...
do. 7% Pref.	£1	6	6	22/6	—	6 4 5
Elec. Supply Corporation	£1	8	10	27/-	—	7 8 2
Kensington Ordinary	£5	12	14	11½	+ ¼	6 4 5
Lancs. Light and Power	£1	Nil	7½	28/-	+1/-	5 15 5
London Electric	£1	10	10	35/6	+6d.	5 12 8
do. do. 6% Pref.	£5	6	6	5⅝	—	5 9 1
Metropolitan	£1	8½	10	1⅞	—	5 6 8
do. 4½% Pref.	£1	4½	4½	17/6	—	5 2 10
Midland Counties	£1	5	5½	23/9	—	4 12 7
Newcastle-on-Tyne Ordinary	£1	2½	6	1⅛	—	5 6 8
do. 5% Pref.	£1	5	5	18/9	—	5 6 8
do. 7% Pref.	£1	7	7	25/-	—	5 12 0
Notting Hill 6% Pref.	£10	6	6	9¼	—	6 4 5
North Met. Elec. 6% Pref.	£1	6	6	1⅛	—	5 6 8
Urban Ordinary	£1	—	4	19/3	—	4 4 8
do. 6% Pref.	£1	5	6	19/6	—	6 3 1
St. James' and Pall Mall	£5	14½	17½	12⅛	—	6 16 0
South London	£1	11	15	2⅞	+ 1/16	6 3 0
South Metropolitan Pref.	£1	7	7	1⅛	—	5 12 0
Westminster Ordinary	£5	12	15	11 7/16	+3/16	6 11 0
Whitehall Elec. Invst. 7½% Pref.	£1	7½	7½	1	—	7 10 0
Yorkshire Elec.	£1	8	8	29/-	—	5 10 4
HOME RAILS.						
Central London Ord. Assented Stock	£1	4	4	74	—	5 8 1
Metropolitan	£1	3½	4	80	—1½	5 0 0
do. District	£1		3½	55½	— ½	6 7 3
Underground Electric Ordinary	£10	Nil	Nil	3½	—	Nil
do. do. "A"	£1	Nil	Nil	10/-	—6d.	Nil
do. do. Income Bonds	£5	6	6	101	—	*5 18 10
TELEGRAPHS AND TELEPHONES.						
Anglo-Am. Tel. Pref.	Stock	6	6	104xd	—	5 15 5
do. Def.	£1	1½	1½	23½xd	+ ½	6 7 8
Automatic Telephone	£1	Nil	3	1 7/8	—	2 1 9
Chili Telephone	£5	6	6	6½	—	*5 6 8
Cuba Sub. Ord.	£10	7	7	7	—	10 0 0
Eastern Extension	£10	10	10	17½	+ ½	*5 14 8
Eastern Tel. Ord.	Stock	10	10	172½	—	*5 16 0
Globe Tel. and T. Ord.	£10	10	10	17½	—	*5 16 0
do. do. Pref.	£10	6	6	11⅛	—	5 7 10
Great Northern Tel.	£10	24	22	£0	—	7 6 8
Indo-European	£25	7	7	32½	—	*5 6 1
Marconi	£1	15	10	1⅞	+ 1/16	5 14 8
Marconi Marine	£1	10	10	1⅛	—	8 17 10
Oriental Telephone Ord.	£1	12	12	1⅞	—	*6 8 0
United R. Plate Tel.	£5	8	8	6⅛	—	*5 1/16 5
Western Telegraph		10	10	17	—	*5 17 8
HOME AND FOREIGN TRAMS, &c.						
Anglo-Arg. Trams First Pref.	£5	12½	5½	8¼	+ 1/16	8 9 2
do. do. 2nd Pref.	£5	6½	6	3	+ ⅛	10 0 0
do. do. 5% Deb.	Stock	5	5	75½	—	6 12 5
British Electric Traction Ord.	£1	5	6	99½	—	6 0 6
do. do. 6% Pref.	£1	6	6	105½	—	5 12 9
Brazil Traction	£100	4	4	38	—	6 18 0
Brit. Columbia Elec. Rly. Pcc.	Stock	5	5	88½	+1	5 13 0
do. do. Preferred	£1	5	90/-	88½	—	*5 8 0
do. do. Deferred	£1	8	129/6	119½	+1	*5 14 8
do. do. Deb.	£1	4½	4½	81½	—	5 4 4
Lond. & Sub. Trac. 5% Pref.	£1	5	2½	6/6	—	7 13 10
London United Tram. Deb.	Stock	4	4	51½	—	7 15 4
Mexico Trams, 5% Bonds	£—	Nil	5	71	—	7 0 10
Mexican Light Common	£100	Nil	Nil	24	—	Nil
do. Pref.	£100	Nil	Nil	52½	—	Nil
do. 1st Bonds	£—	5	5	66	—	7 11 6
Yorkshire (West Riding)	£1	—	5	1¼	—	4 0 0
MANUFACTURING COMPANIES.						
Babcock & Wilcox	£1	20	12	55/9	+9d.	*4 6 8
British Aluminium Ord.	£1	5	5	22/-	—	3 2 6
British Elec. Transformer Pref.	£1	Nil	Nil	14/3	—	... ...
British Insulated Ord.	£1	15	15	3	— 1/16	5 0 0
Brush Ord.	£1	10	10	24/6	—	8 3 4
Callenders	£1	15	15	3	— 1/16	5 0 0
do. 6½ Pref.	£1	6½	6½	23/9	—	5 9 5
Crompton Ord.	£1	5	Nil	¾	—	...
Edison-Swan	4/-	7½	10	6/6	—	6 3 0
do. 5% Deb.	Stock	5	5	81½	—	6 0 3
Electric Construction	£1	10	10	34/6	—6d.	5 11 0
Enfield Cable, Pref.	£1	7½	7½	24/-	—	6 5 0
English Electric	£1	8	5	20/3	—	4 18 9
do. do. Pref.	£1	6	6	21/6	—	5 11 7
Gen. Elec. Pref.	£1	6½	6½	23/3	—	5 11 10
do. Ord.	£1	5	5	23/3	—6d.	4 6 0
Henley	£1	15	15	3	—	5 0 0
do. 4½ Pref.	£5	4½	4½	4½	—	5 6 0
India-Rubber	£1	10	5	17/6	—	*5 14 3
Johnson & Phillips	£1	5	5	1⅛	—	3 15 2
Met-Vickers, Ord.	£1	12½	8	1¼	—	6 8 0
do. Pref.	£2	8	8	2½	—	6 8 0
Siemens Ord.	£1	5	—	1¼	—	4 0 0
Telegraph Construction	£12	20	20	26½	—	*4 10 6

*Dividends paid free of Income Tax.

Electrical Accidents in Mines.

THE report of H.M. Electrical Inspector of Mines for the year 1923 has been issued as a separate report and published at the price of 6d.

Hitherto this has been incorporated in the Chief Inspector's report, but now owners and managers of mines may obtain copies for distribution to their electrical staff at a small cost, and we feel sure this concession will be very much appreciated.

During the year 1923 the use of electrical power increased by 124,571 h.p., making a total of 1,364,745 h.p., as against 1,240,174 h.p. in 1922. The total number of mines at work was 2,902, a decrease of nine below 1922, and the number of mines using electricity was 1,598, an increase of forty-one above 1922.

It is very regrettable that there were no less than 14 fatal accidents, causing the loss of 15 lives, which were attributable, directly or indirectly, to the use of electricity, two occurring on the surface and twelve below ground. Of the total number of deaths, 10 were directly due to *electric shock*, three to ignition of methane, one to the explosion of an oil-break circuit-breaker, and one to injury received from a rotating drill following an electric shock.

In one respect, however, it is satisfactory to note that although since 1912 the use of electricity below ground has increased from 316,667 h.p. to 753,138 h.p. in 1923, it cannot be said the death rate has increased in proportion, but, unfortunately, this is the worst record since the year 1910, when the same number of lives were lost. In 1911 there were 9 lives lost; 1912, 7; 1913, 13; 1914, 4; 1915, 8; 1916, 4; 1917, 2; 1918, 6, 1919, 6; 1920, 3; 1921, 1; 1922, 6; and 1923, 9.

We give below the particulars of each fatal accident, from which useful lessons can be drawn, and following this the inspector's notes on non-fatal electrical accidents and underground fires due to electricity.

Fatal Accidents.

1.—No. XI Lumphinnans Colliery, Fife. January 26th.

Deceased, aged 19, employed as a motor-man, was in charge of a 35-h.p. haulage below ground. The fuse fittings for the hauler were housed in a cast-iron box which also contained other fuses for automatic protection of another circuit supplying a dook pump. Both sets of fuses were controlled by one switch of the oil-break automatic-trip type, but there was no constructional provision to prevent access to the fuses whilst "live," such as would be afforded by interlocking the cover of the fuse box with the controlling switch, and, moreover, when the fuse box was open, there were unshrouded "live" terminals exposed so that they might be touched.

It is presumed that deceased touched one or more of these "live" terminals and so received an electric shock, which proved fatal.

The system was three-phase, with free neutral, and the pressure was 500 volts.

2.—Holmes, No. 4 Pit, Ayrshire. January 17th.

Deceased, aged 31, was the electrician in charge of the plant. It appears that he was attempting to make a connection between the star, or neutral point, in the terminal box of a large induction motor and the frame while the motor was running, having previously made a similar connection in another motor installed in the same pump room below ground. His object appears to have been to secure an electrical pressure suitable for the primary circuit of a small transformer that had been procured for the purpose of providing a low-pressure circuit for local lighting. The transformer was designed for a primary pressure of 1,730 volts, which was approximately the pressure existing between the star, or neutral point of the pump motor circuit, and each phase of the three-phase high-pressure system.

The pressure between phases was 3,000 volts, and the neutral point was "free." Deceased was ignorant, presumably, of the potential danger of this free neutral point.

3.—Hetton Colliery, Durham. February 14th.

Deceased, aged 18, was a clerk employed in the drawing office, above ground, and had been engaged for some two years working an electric arc photo-copying machine, used for the production of blue prints from tracings. Deceased doubtless received the fatal shock by simultaneously touching the lamp terminal and the cable end so as to complete the electrical circuit through his body. The lamp terminals were unprotected, and the construction of the apparatus was such as to make it potentially dangerous to technically ignorant persons. The pressure of the circuit was 230 volts, derived from two phases of a three-phase system with free neutral.

4.—Tudhoe and Croxdale Colliery, Durham. May 3rd.

Deceased, aged 17, an apprentice electrician, was at work in a pump room underground, when he received a fatal electric shock from the terminals of a voltmeter, which were normally enclosed within the framework of a pedestal switch, the connections of which he was attempting to dismantle. He touched the bare terminals of the voltmeter, which were connected to the "live" side of the switch, which was not of the self-isolating type, and there was no switch for isolating the circuit nearer than a point some 1,165 yards distant outbye.

It would appear that deceased was aware of the risk, but thought he was skilful enough to avoid an accident. The system was three-phase at 600 volts, with the neutral point earthed.

5.—Littlemill Colliery, Ayrshire. May 21st.

Deceased, aged 23, was a repairer, and had been at work in the shaft. His body was found beside a cable disconnecting box, the cover of which was open, and it is presumed that he had opened the box and either touched or fell on to the bare terminals. His motive was not determined, curiosity being suggested, as he had on occasion helped the electrician. The cover of the box being hinged and arranged to be kept closed by two swing bolts secured by wing nuts, it could be opened by anyone without tools. The system was direct current at 500 volts, insulated.

6.—Auchincruive Colliery, Ayrshire. June 3rd.

Deceased, aged 33, was employed as a bottomer, and had evidently just entered the haulage engine room to start the motor when a loud report was heard, and he was found lying unconscious in front of the switchgear which controlled the haulage motor.

The switch in question comprised a main oil-break circuit-breaker designed for 3,000 volts, three-phase, enclosed together with a small transformer in a large cast-iron cabinet having a heavy hinged door fitted with an external rotary handle engaging with the operating mechanism of the switch. This door was broken in several pieces, which were thrown outwards, as the result of an explosion within the cabinet, and the sheet metal oil tank of the circuit breaker was detached from its fastenings. There was evidence that an arcing discharge, constituting a short circuit across two phases of the three-phase system, had occurred between connections external to the circuit breaker case and the heads of two bolts adjacent thereto. These connections completed the circuit between the outgoing cable terminals and the overload trip coil windings inserted on two phases.

There was evidence that one of the switch contacts under oil was in a seriously defective condition. It is probable that in consequence of this defective contact, the oil in the switch tank was "cracked," resulting in the formation of inflammable gases which made an explosive mixture with the air in the cabinet, which was ignited by an electric arc.

This is, however, an alternative explanation which has a bearing on the practice which is adopted at this and many other collieries of operating a three-phase system with a floating or unearthed neutral point. Assuming that the deceased did succeed in putting this main switch "on," as was his evident intention, and having regard to the condition of the contact on one of the three phases in the switch, there would be a considerable momentary disturbance of the normal balance in the three-phase system, with the result that a surge of pressure might occur. Such a surge may have been sufficient to cause an electrical discharge between the conductors, which were lightly covered with insulating tape, and the bolts which were at earth potential.

The risk of such a failure of insulation, consequent upon a pressure surge, may be substantially reduced by earthing the neutral point of the three-phase system through a limiting resistance of suitable design. The electricity regulations under the Coal Mines Act, 1911 (which were made in 1913), in deference to an important body of opinion which was opposed to the principal of earthing, allowed the alternatives of operating a three-phase system either with an earthed neutral point or with an insulated, *i.e.*, floating or free neutral point.

At the present day, however, it is generally admitted that the balance of advantage is substantially on the side of earthing the neutral point, and it is to be hoped that mining interests will voluntarily come into line with the best present-day practice in this respect.

7.—Emley No. 3 Drift Pit, Yorkshire. June 15th.

Deceased, aged 36, and employed as a "tupper," was in charge of an electrically-driven rotary-drill heading machine. Deceased received an electric shock from the machine, which caused him to fall against it in such a way that a projecting cotter pin, used for attaching the drill to the machine, which was revolving at the time, struck him in the region of the

left eye, perhaps repeatedly, so as to shatter the roof of the left orbit and part of the base of the skull.

It was found that the insulating covering of one of the live conductors of the trailer had been unbraided, so that the bare copper conductor was touching a part of the machine, and that the earthing conductor in the trailer was broken off from the bolt to which it was normally attached.

These defects are attributable to the use of the machine in a defective condition, the terminal box being broken. The electrician examined the apparatus before it was sent down the pit some 18 days before the accident and again, cursorily, in the pit some nine days afterwards, but it was not seen by him after it was taken into the heading for use.

The defective condition of the terminal box was known to deceased and to other miners, including two of the deputies, but the danger involved was not realised by any of these men.

The casting had been broken when the machine was first unloaded in the pit by tipping it from a tub on to the floor of an engine room, a drop of some three feet from the rail level. The system was 3-phase at 550 volts, the neutral point being free.

8.—Wimblebury Colliery, Staffs. July 6th.

Deceased, aged 28, an electrician, had been called out after leaving work and instructed to look for an earth fault on an overhead transmission line having two pits situated about 1,200 yards apart. Having observed that one of the bare copper conductors was touching the masonry of a boiler chimney, he telephoned to the banksman at the other pit and directed him to enter the sub-station and switch off the line. Observation of a voltmeter in the switch house showed that the line had been made dead, and deceased climbed upon the masonry and was holding two of the live conductors when pressure was switched on by the banksman, with the result that the electrician received an electric shock which proved fatal.

It would appear that failing any rigid routine for ensuring the safety of workmen at the distant end of an electrical circuit undergoing repairs, there was insufficient personal supervision or detailed instruction by those in responsible charge.

The system was 3-phase at 650 volts, with free neutral.

9.—Auckland Park Colliery, Durham. August 25th.

Deceased, aged 30, a coal-cutting machine man, was operating a longwall chain-type machine adapted for heading, and driven by a squirrel-cage electric motor controlled by a star-delta airbreak switch, when an accumulation of methane was ignited whereby he and another man were seriously burned; deceased succumbed to his injuries three days later.

From information supplied by the injured man and others, and judging from an examination of the enclosure of the electrical parts of the machine, it is probable that a local accumulation of methane and air, in explosive proportion, was ignited by the break-flash at the switch contacts.

Although there were no bolts missing, the enclosure of the switchgear was not such as to be likely to be flame-proof, owing to wear and alterations.

The electrical system was 3-phase at 220 volts, with free neutral.

10.—Bolsover Colliery, Derbyshire. September 9th.

Deceased, aged 30, an assistant electrician, was cleaning the interior of an ironclad switch in the pit-bottom sub-station controlling one of two feeders connected in parallel to bus-bars, when he touched a live terminal and received an electric shock which proved fatal. He either forgot or did not know that it was not sufficient to isolate on one side only of such a current, and it appears to have been left to his discretion to take such measures as were necessary for his safety. There was no effective reminder or preventative, such as would be afforded by padlocks or by warning and instructive lettering on the switches to ensure correct procedure.

The system was 3-phase at 2,200 volts, with free neutral.

11.—Heworth Fanny Colliery, Durham. September 12th.

Deceased, aged 34, working with a coal-cutting machine, received a fatal electric shock from the cast-iron cover of a gate-end switch that he was about to open, under the supervision of the machine man in charge, in order to examine the fuses because the machine could not be started.

It was found that, as a result of falls of rock consequent on the firing of two shots in the roof of the gate road, an armoured cable had been drawn out, for a length of 6 inches, from one end of a joint box in such a way that one of the conductors in the cable was touching the metal shell of the joint box; the earthing circuit was interrupted, and the armouring of the cable and all apparatus in electrical contact therewith became "live."

It does not appear to have been the specific duty of any official to see that cables and relative apparatus were properly protected prior or subsequent to the firing of shots.

The cable in question was 3 core, .05 sq. in., wire armoured, and the joint box was equipped with a good type of mechanical connector and armour clamp. The box was filled with insulating compound, and the system was 3-phase at 625 volts, and the neutral point was earthed.

12.—Aitken Pit, Fifeshire. October 9th.

Deceased, aged 30, a coal-cutting machine man, had withdrawn the bat, or plug connector, from the machine which he was working and received a fatal shock from the projecting contact pin which he attempted to pull out before cutting off the electrical pressure at the gate-end switch. It is presumed that deceased pulled out the plug to ascertain why the machine would not start at a certain stage of the work, and finding that the pin had come away he, in the excitement of his discovery, forgot that it was still part of the "live" electric circuit.

The system was 3-phase at 500 volts, and the neutral point was free.

13.—Foulford No. 1 Mine, Fifeshire. November 8th.

Deceased, aged 29, was employed as a conveyor shifter, and received a fatal shock from the framework of a conveyor engine while attempting to pass between it and the wall. A trailing cable was lying across the conveyor engine, which was not in use on that shift, and was connected to the coal-cutting machine at one end and to the gate-end switch box at the other end.

A repaired place was found in the dielectric of the cable in that part of it which lay upon the conveyor engine, and upon testing the cable it was found that this repaired portion was in such a condition as to make it probable that the conveyor framework was charged electrically by the leakage through the "Empire cloth" and adhesive tape.

The system was 3-phase at 500 volts, with free neutral.

14.—Whitfield Colliery, Staffs. December 21st.

Four men were burned by ignition of methane, two so seriously that one died a few hours later and the other six days after the occurrence. They were working a chain type coal-cutting machine driven by a series-wound direct-current motor at 500 volts, when a body of gas, which had accumulated, was ignited, probably by a break-flash at the switch contacts. It was found that two screws were missing from the terminal box cover on the machine, with the result that there were two openings, each about 11/16 in. diameter, through which gas could enter the switch box, and from which flame could issue in a condition to ignite an inflammable mixture of methane and air external to the machine. There was also another bolt missing from the cover plate over the commutator of the motor.

The machine men had been warned verbally to replace all bolts and covers, but a design which necessitates the opening of electrical enclosures by machine men is not suitable for places where gas may occur in dangerous quantity.

Non-fatal Electrical Accidents and Dangerous Occurrences.

During the year 49 notices were received of non-fatal electrical accidents, at the time of their occurrence, and 21 further notices were received later, making a total of 70 accidents of this class.

It is a matter of concern that nearly 30 per cent. of the number were not notified at the time of the occurrence, as required by Section 80 of the Coal Mines Act, 1911, so that the fact that an accident had occurred was only discovered when the annual return, which is required by Section 18 of the Coal Mines Act, 1911, was received and analysed.

Investigations were made by the Inspectorate and remedial measures, where possible, were suggested with a view to eliminating such weaknesses in design or practice as were disclosed by the circumstances.

Thirty-six of these accidents occurred below ground and 32 on the surface works at mines under the Coal Mines Act, one at a china clay working and one in a tin mine. In 65 instances there was some personal injury affecting in all 72 persons. In one of these, five persons suffered burns due to the ignition of gas at a coal-cutting machine, and in another, two persons were overcome by the fumes resulting from a burning cable which was set on fire by a short circuit. In one case a large oil-break reversing switch exploded, causing slight injury to two persons. There were in all four cases of fires below ground due to defects in electrical cables, and these are described, subsequently, as lessons that may be learned from the attendant circumstances.

Most electrical accidents are, hypothetically, avoidable, and those under review may be classified as follows:—

Twenty-two attributable to faults of design or construction or unsuitability for the particular service;

Fourteen attributable to defects of maintenance;

Twenty-four attributable to misuse, negligence, ignorance or meddling; and

Ten attributable to normal risks, judged to be unforeseeable.

Grouping the accidents according to the description of the electrical apparatus involved serves to indicate approximately the relative vulnerability of the component parts of the electrical installation, and with that object the following summary is included:—

	Accidents.
Switchgear	34
Trailing cables and plugs	18
Armoured cables	7
Overhead lines and unarmoured cables	5
Dynamos and motors	2
Lighting accessories	3
Bell signal system	1

(To be continued.)

The Pacific Cable Board.

Annual Report.

THE annual report and accounts of the Pacific Cable Board for the year ended March 31st, 1924, outline the year's working and show that the receipts of £551,788 exceeded the ordinary working expenses (including the normal payment of £30,000 to the reserve and renewal fund) by £250,777. After taking account of the annuities of £77,544 payable to the National Debt Commissioners in respect of interest and repayment of capital, and of £9,150 payable to the reserve and renewal fund in respect of interest and repayment of money borrowed from that fund for the Sydney-Auckland Cable (1912), a surplus of £164,082 remained, and the Board is of opinion that the whole of it should be again devoted to the reserve and renewal fund. The traffic receipts, £544,781, exceeded those of the previous year by £35,482.

There was again a substantial increase both in the volume and value of the international traffic carried, as compared with that of the previous year, resulting principally from the growth of the deferred ordinary, Press, and week-end classes and from new traffic created by the introduction of the daily letter telegram service.

The expenditure (excluding special appropriations) exceeded that of the preceding year by £28,081, and was higher by £22,510 than the original estimate; most of it was due to expenditure of a special non-recurrent nature. The total assets of the reserve and renewal fund amounted to £2,000,304, and it was anticipated that the resources of the fund would now be adequate to provide for carrying out a cable duplication scheme.

All the cables have been free from interruption throughout the year, and no repairs have been necessary. The new tricore shore-end at Bamfield on the Fanning Island section was laid in June, 1923, at a total cost of £21,246, and the modification of the shore-end has enabled improved methods of working to be adopted, with the result that the speed of working has been increased by nearly 20 per cent., *i.e.*, from 110 to 130 letters per minute (paying traffic). But for this improvement, the system would now be seriously embarrassed, as the capacity of the cable would have been inadequate for the present volume of traffic. The new cables which were laid during the year under review between Auckland and Suva and between Sydney and Southport as part of the scheme for the duplication of the system, were brought into operation towards the end of 1923, and the anticipated improved circulation of traffic has been fully realised.

The actual cost of the new cables was £331,113, and has been provided from the reserve and renewal fund; £247,699 of this sum has entered into the accounts of the year under review, but the advantage of the increased carrying capacity cannot be fully utilised until the facilities north of Fiji are augmented. The Board considered providing additional means of communication between Canada and Fiji, the need for which is urgent, but a decision was deferred till the results of certain improved types of cable could be ascertained, and also in view of the discussions relating to wireless systems. The expedition which was sent to Vancouver Island and to Fiji to obtain data for high-power wireless stations in those localities had not completed the investigations at the close of the year.

At the request of the Imperial Government, the board has undertaken the management of the telegraph system in course of installation in the British West Indies and British Guiana, comprising a cable from Turks Island to Barbados, with branch cables from Barbados to Trinidad and from Barbados to Georgetown (Demerara) and wireless stations at Barbados and the following other islands:—St. Kitts, Antigua, Dominica, St. Lucia, St. Vincent, and Grenada. The board will not assume any financial responsibility with regard to this new system, but will act entirely as an agent.

On the death of Sir Henry Babington Smith, G.B.E., C.B., K.C.B., C.S.I., Sir William H. Mercer, K.C.M.G., was appointed chairman, and the vacancy in the representatives on the Board of the Imperial Government was filled by the appointment in November, 1923, of Mr. M. F. Headlam, C.B., one of the Assistant Secretaries of H.M. Treasury. Mr. W. L. Griffith, one of the representatives of the Government of the Dominion of Canada, retired in August, 1923, and Sir Campbell Stuart, K.B.E., was appointed in his stead. Mr. J. E. Dicketts, a senior superintendent, retired on pension during the year under the age regulation. He had been in the Board's service from the time the cable was laid. The vacancy was filled by the promotion of Mr. J. Letters.

The Board's maintenance steamer *Iris* was engaged upon surveys between Auckland and Fiji in April, 1923, and was commissioned under charter to other administrations in September, 1923, during which she carried out repairs to the Eastern Extension Co.'s Sydney-Wellington No. 1 cable and to the New Zealand Post and Telegraph Department's Cook Straits cables. Captain W. R. Holmes, R.N.R., who had been in command of the *Iris* since 1914, retired from the Board's service on pension in July, 1923, having reached the age limit. He was succeeded by Captain H. R. Hughes, R.N.R., formerly chief officer, and the other permanent officers were advanced one step.

During the year approximately 11,200,000 paying words of international traffic (*i.e.*, other than local messages between Australia, New Zealand, and the Pacific Islands) were transmitted across the Board's system. This was approximately 1,200,000 words in excess of the total during the previous year, and establishes a further record. The ordinary or full-rate international traffic showed a falling off of approximately 230,000 words, and the Government a falling off of approximately 65,000 words. There was another increase of 65,000 words in the total deferred ordinary traffic. The traffic of this class between the United Kingdom and Australia and New Zealand was less by 65,000 words, and the increase of the total traffic was due to the American proportion being 130,000 words more than in the previous year. There were also increases in week-end telegrams of 395,000 words and in Press telegrams of 235,000 words. To these increases must be added approximately 850,000 words of new traffic of the daily letter telegram service, which was introduced during the year under review, to which the decrease of the full-rate ordinary traffic is attributed mainly. The charges for messages of the new class are a quarter the rates for ordinary telegrams.

In addition to the international traffic, approximately 2,050,000 paying words were carried between Australia and New Zealand and between those Dominions and the Pacific Islands, approximately 40,000 more than during the previous year. At the end of 1923 the Commonwealth Government decided to permit the cable administrations in future to undertake the collection and delivery of intercolonial traffic. While the effect of the modification of practice is in the public interest, as it allows the traffic to be more expeditiously handled, it involves the Board in higher working expenses, while the Commonwealth Government continues to receive the same terminal rate on the traffic as when it carried out the collection and delivery work.

Tramcars v. 'Buses in America.—At an American Street Railway Convention held two or three months ago a visiting official remarked that, judging from the character of the exhibits, he might well conclude that he was in attendance at an automobile show. The manufacturers of 'buses and 'bus accessories displayed no end of industry in placing before the visiting tramway officials a wide variety of their wares, while electric track service equipment was little in evidence. One visitor offered the view that the trolley cars were all busy hauling passengers and that the manufacturers of electric equipment were too busy filling orders to have time for the convention. There has been in some quarters, says the *Journal* of the A.I.E.E., a disposition to view with alarm the competition of 'buses, but there are certain factors having a bearing upon the trend which it is well to keep in mind. The continuous increase in population and the increase in the number of privately operated automobiles are rapidly creating a situation that makes the available street way inadequate for the safe and rapid movement of vehicles. The possibility of providing greater road space is hedged about with many obstacles. The growth of traffic in the streets and at intersections, to an alarming extent, is increasing the number of accidents to pedestrians and to passengers in auto-cars. There is something fundamentally right, says the *Journal*, about a passenger transit system which employs tracks, and operates cars of liberal dimensions and sturdy construction, such as electric street cars may be. Pedestrians have much less difficulty in avoiding cars that run on tracks, the location of which may be seen—cars which cannot dodge about on the street—than in keeping clear of free-moving vehicles which flit from side to side like the proverbial flea. Of course, for feeder routes leading into main highways the 'bus is performing a much needed service, but on the main highways where passenger travel is heavy, and on which private automobile traffic is dense, the electric car on rails provides the most logical method of transport from the standpoints of safety, comfort, and speed.

The Physical Society of London.

Annual Exhibition of Instruments.

(*Continued from page* 155.)

H. W. Sullivan, Ltd.

Amongst the varied exhibits of this firm was a standard multivibrator wavemeter, due to Mr. D. W. Dye, of the National Physical Laboratory, which depends for its action upon the control of the fundamental frequency of an Abraham Bloch multivibrator by a standard tuning-fork, auxiliary apparatus for the selection and selective amplification of the desired harmonics from the multivibrator being provided. Two valves are symmetrically coupled together as shown in fig. 14 to govern a "low-frequency" multivibrator generating a discontinuous current having a fundamental frequency of 1,000 periods per second and a wave form (rich with harmonics) as shown in fig. 15; the period of the cycle is, roughly,

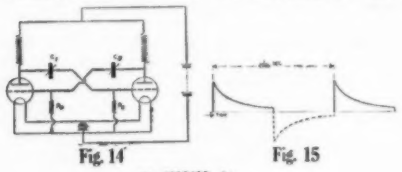


Fig. 14

Fig. 15

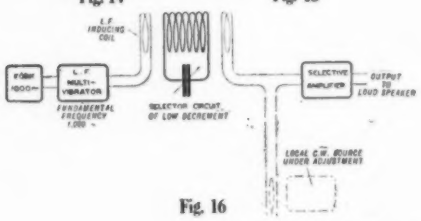


Fig. 16

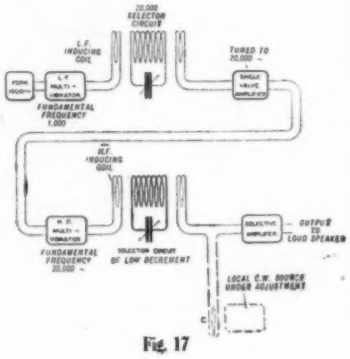


Fig. 17

Figs. 14 to 17.—Multivibrator Wavemeter Diagrams.

equal to C_1R_1 *plus* C_2R_2. This self-vibrating arrangement has its oscillation frequency controlled by electric impulses from a standard, valve-maintained, tuning-fork of 1/1,000 sec. period. Elinvar steel, having a very small temperature coefficient is used for the construction of the fork, which is calibrated by a phonic motor and standard clock, and is extremely constant. The low-frequency multivibrator is brought within the range of synchronisation by slightly varying the capacities C_1 and C_2 (fig. 14).

For the measurement of radio frequencies up to 120 kilocycles per sec., a coupling coil is inserted in the grid circuit of one of the valves at x (fig. 14), in order to induce into an efficient selector circuit of low decrement consisting of a special low-loss variable air condenser of high permanence and a number of air-spaced interchangeable coils. The variable condenser of this circuit is designed to have an even scale of frequency. The selector circuit may be tuned to select any desired harmonic up to the 120th, and the harmonic, thus reinforced, is induced into another coil connected in the input circuit of a four-valve selective amplifier consisting of one radio-frequency amplifying stage (tuned-anode coupled), a detecting stage, and two low-frequency amplifying stages.

The scheme for the measurement of frequencies up to 120 kilo-cycles is shown in fig. 16. The selective amplifier is naturally tuned to the frequency of the harmonic being selected, and amplifies not only this harmonic, but also the continuous oscillation with which it is required to heterodyne, which is superposed upon the harmonic through the medium of the additional coupling coil c. In order to obtain frequencies above 120 kilo-cycles per sec., a second multivibrator (high-frequency) is set operating to supply to the inducing coil impulses having a fundamental frequency of 20 kilo-cycles per sec., from which can be selected, in the manner outlined above, harmonics up to the 60th, giving frequencies up to $60\times20{,}000=1.2\times10^6$ per second, corresponding to wavelengths down to 250 metres. For this range of frequencies three inductance coils of low decrement similar to those used with the low-frequency mutivibrator are used. The high-frequency multivibrator, however, has also to be held in synchronism by the tuning-fork in the manner outlined in fig. 17.

The low-frequency mutivibrator, vibrating at 1,000 periods per second and held in synchronism by the tuning-fork, being no longer required to impulse the low-decrement selector circuit, induces into another selector circuit which is tuned to select the 20th harmonic of the low-frequency multivibrator fundamental, *i.e.*, 20,000 cycles. This reinforced harmonic is then amplified by a single valve having its anode circuit tuned to the harmonic frequency, and the amplified 20 kilo-cycles per sec. energy is used to control the high-frequency multivibrator, the latter being brought within the range of synchronisation by means of coarse and fine filament current regulation.

When adjusting a local source of oscillation to an exact frequency by means of the standard wavemeter, using the l.f. multivibrator, the heterodyne beat is heard from the loud speaker. In addition, however, when the source has been set to exact synchronisation with the selected harmonic (*i.e.*, where there would ordinarily be dead silence) a note of 1,000 cycles per second is heard, due partly to direct coupling from the multivibrator and partly to rectification by the selective amplifier of the modulated current in the selector circuit. This residual 1,000 frequency note assists calibration by providing other synchronising beats, when the source is varied off the exact synchronisation point, due to the synchronisation beating between the 1,000-cycle permanent note and the 1,000-cycle heterodyne beat note, and at certain other heterodyne beat notes (such as 666.7, 500, 333.3, 250, and 200) due to the synchronisation beating between these beat notes themselves (or harmonics of them) and difference tones due to the interference between the beat notes and the permanent note of 1,000 frequency.

When using the h.f. multivibrator for frequencies above 120 kilo-cycles per sec., sub-harmonics occur when the source is varied off the setting of exact synchronism with the selected harmonic, and these give intermediate standardisation frequencies between the main harmonics, which are, of course, 20 kilo-cycles per sec. apart when using the h.f. multivibrator.

Marconi's Wireless Telegraph Co., Ltd.

This exhibit consisted of an installation that has been newly designed for the purpose of amplifying speech and music for "loud-speaker" reproduction, for playing gramophone records for large audiences, or, alternatively, for broadcasting. The complete outfit consists of the following apparatus (fig. 18, from left to right): A gramophone attachment, consisting of a magnetic pick-up device, a high-class micro-

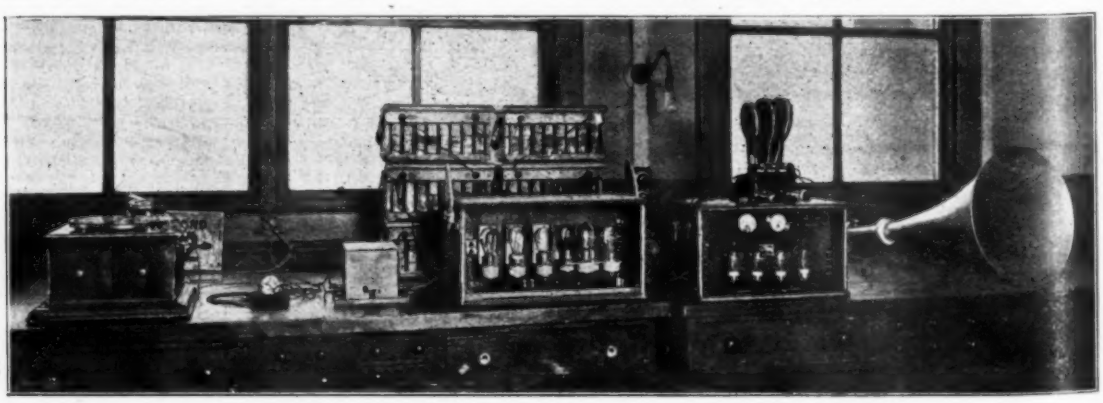


Fig. 18.—A Marconi Speech Amplifying Outfit.

phone, arranged for stand or breast use; a gramophone-microphone change-over switch; an amplifier; and, for alternative use, a 50-watt broadcast transmitter and a "loud speaker."

Watson & Sons (Electro-Medical), Ltd.

The Victor C.D.X. X-ray apparatus, fig. 19, is unusual in that the tube is directly connected with the h.p. transformer, and both are immersed in oil in an earthed container, thus being self-contained. All external h.p. leads are eliminated, and with them the need for excessive caution which has

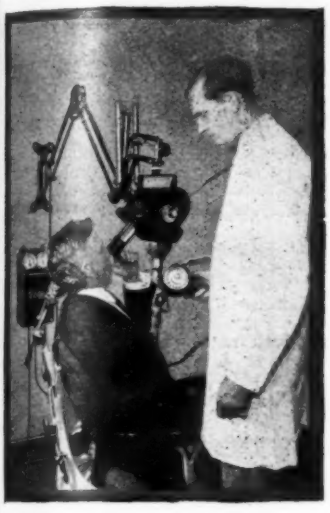


Fig. 19.—Watson Dental X-Ray Outfit.

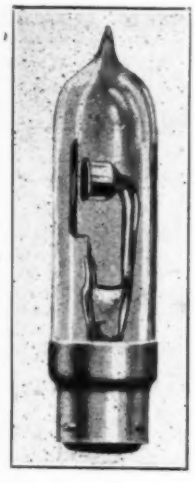


Fig. 20.—G.E.C. Gas Discharge Lamp.

hitherto stood in the way of the more general introduction of X-ray equipment for dental and similar uses, for which a peak output of 70,000 volts is sufficient. For dental work the container is mounted on a wall bracket of novel design, which is sufficiently flexible to give the correct position for any tooth (right or left, upper or lower) without re-adjustment of the patient's head. The h.p. transformer is operated by

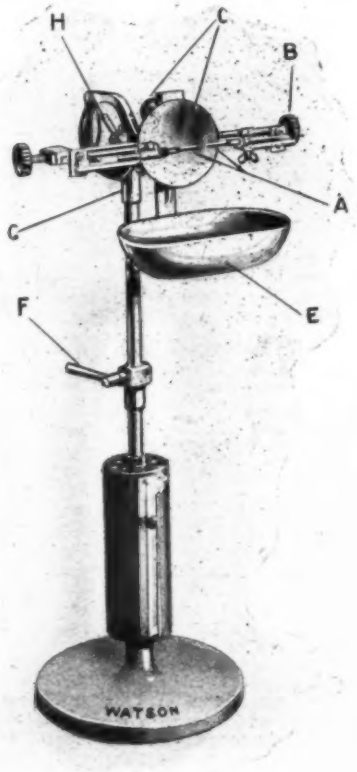


Fig. 21.—The Hall Tungsten Lamp.

an insulated auto-transformer contained in a wall case upon the angled top of which are mounted the voltmeter and ammeter; this circuit also is earthed.

The Hall tungsten lamp is designed to burn solid tungsten rod which, in addition to a visual spectrum of great intensity, emits radiations of practically every wavelength in the ultra-violet down to the point where the wavelength is so short as to be absorbed by the oxygen of the atmosphere. In the absence of definite information as to the best therapeutic range, the extended range and continuity of radiation obtainable with this lamp makes it most useful both for clinical use and research. It can be used for general irradiation or focal work, and is fitted with an adjustable resistance mounted on a separate switch-panel, or complete in itself with resistance on the upright stand, as illustrated in fig. 21; A represents the tungsten electrodes, B the milled heads for fine adjustment of the feeding mechanism, C the focal mirror interchangeable with shield (not shown), E the splutter bowl, and F, G, H the mechanical adjustments of the lamp as a whole for height, rotation, and tilt respectively.

Adam Hilger, Ltd.

Amongst the apparatus shown on this stand was Dr. Müller's X-ray spectrograph with additions, whereby the methods of Bragg, Hull, Debye and Scherrer, Schiebold, and Laue can be employed at will; the Shearer X-ray tube for use with this spectrograph was also shown in operation; high purity electrodes for spectrometer work consisting of Ilminite (titaniferous iron) which has the remarkable property of sustaining an arc for hours with a current of only about ½-1 ampere; inspection apparatus for examining test bores in large forgings, such as are used for turbo-generators; insulating oil spark gap (British engineering standards pattern) for determining the electric strength of oils, made to the order of Metropolitan-Vickers Electrical Co. At the instance of Messrs. Adam Hilger, the General Electric Co., Ltd. (England) has produced d.c. gas lamps which give a steady glow suitable for spectroscopic and interferometric work. They can in most cases be used with advantage in place of the ordinary vacuum tube on grounds of convenience, brightness, and life; they are provided with a bayonet fitting, but adaptors to suit the Edison screw socket can be supplied. The form of the lamp, which is approximately 3½ in. high and ¾ in. in diameter, is indicated in fig. 20; the radiating area is very small, the necessity in most cases being that the source should have as great intrinsic brightness as possible.

Oxygen, nitrogen, CO_2, helium, argon, neon, hydrogen, krypton, and xenon discharge lamps are available, and also lamps with quartz windows for the ultra-violet; the recommendation in 1922 by the International Astronomical Union of certain lines of neon as wavelength standards, the richness of its spectrum in the red and yellow, and the extreme sharpness of the individual lines, give special importance to any simple means of producing neon radiations; the neon lamp is also very useful for interferometric work. The well-known Osglim lamp has been of great service, but has insufficient intrinsic brightness to be satisfactory for spectroscopy or interferometry.

It must be pointed out that under the conditions necessary for the production of hydrogen discharge lamps, the Balmer lines are faint, the secondary spectrum always being radiated in preference; this difficulty is a fundamental one. Mr. R. W. Wood has shown that the metal electrodes in discharge tubes act as catalysts, converting atomic into molecular hydrogen, and thus in their neighbourhood there will be comparatively little atomic hydrogen. Oxygen lamps can now be made giving a very pure spectrum; the bands of CO_2, however, make their appearance after several hours burning, but they do not very seriously mask the oxygen lines; in fact it is difficult to make the ordinary form of spectrum tubes which do not show traces of the CO_2 spectrum immediately when sealed off the pump. Argon lamps show both the red and the blue spectrum, but the blue is brighter than the red spectrum. Krypton and xenon lamps give lines belonging mainly to the "second spectrum" in each case, although the brighter of the "first spectrum" lines also appear. The best voltage for these lamps varies somewhat; it is usually possible to select from stock lamps of helium, argon, and neon suitable for any voltage from 190 to 250, and the best results are obtained by keeping about the middle of the range. The current taken by the lamps is from about 5 to 15 milliamperes. The helium lamps contain a small trace of hydrogen; argon lamps have about 2 per cent. of hydrogen and 1 per cent. of nitrogen, the hydrogen being added to reduce the starting and running voltages.

Crompton & Co., Ltd.

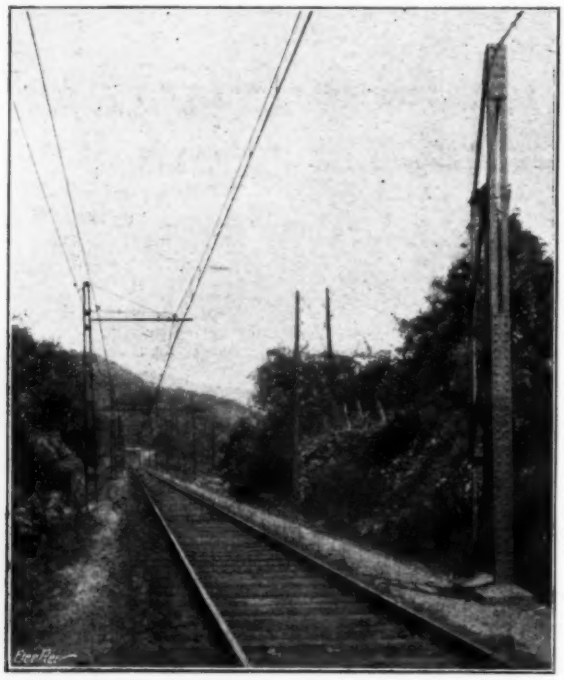
Besides a steoboscopic vibrator and standard laboratory apparatus, a selection of 2½-in. dial and educational-type instruments were on view; the latter have totally glazed fronts, cut-away scale plates and exposed movements so that they combine the dual *rôles* of ordinary indicating instruments and of demonstration models. The Crompton-Robertson bridge potentiometer was designed for use in educational laboratories to meet the double purpose of an ordinary four-gap slide-wire bridge and a simple type of potentiometer. The form mentioned is well known, but additional apparatus has now been designed which converts the set into one for milli-volt measurements, thereby making it suitable for use in meter and instrument test-rooms, and for thermo-couple calibration. The maximum inaccuracy of the set is 1 in 1,000, thus giving double sub-standard accuracy.

(To be continued.)

The Electrification of the Spanish Northern Railway.

THE electrification of the Spanish Northern Railway, no doubt expedited by questions of coal transport during the war shortage, is now being commenced. The section between Ujo and Dusdongo is being electrified as the initial step to an extensive programme, and a contract has been awarded to the Sociedad Iberica de Construcciones Electrices, the Spanish representatives of the International General Electric Co., providing for the installation of two 3,000-kW sub-stations, overhead line equipment for the complete project, and six 3,000-volt locomotives. Other locomotives have also been ordered from other manufacturers.

Power purchased from the hydro-electric system of the Electra de Viesgo Co., is transmitted at 30,000 volts, 3-phase, 50 cycles, to sub-stations situated at Pajares and Cobertoria, where it is converted to 3,000 volts d.c., two three-unit 1,500-kW motor generators being installed at each station. Transformation from 30,000 to 3,500 volts takes place before conversion, two 1,900-kVA transformers being installed at each sub-station for this purpose. Compensating taps are provided in each of the secondary transformer windings, 2½ per cent. for line voltage variation and 50 per cent. for starting the



Section of Electric Railway in Spain.

motor generator sets. The generators are designed for 1,500 volts and are permanently connected in series for 3,000-volt operation. They are separately excited by small 125-volt generators mounted on one end of each set, and are equipped with commutating poles and compensating windings to ensure perfect commutation under all load conditions.

Excitation for each synchronous motor is provided by a second 35 to 150-volt d.c. generator placed on the opposite end of each set. To ensure correct power factor and stable operation, the series winding of this exciter carries the 3,000-volt line current. Each set is designed for 150 per cent. overload for two hours and 300 per cent. overload for five minutes.

The overhead construction consists of the General Electric Company's modified flexible catenary type, known as the twin catenary type, and comprises two 4/0 copper wires flexibly suspended side by side from the same ¼-inch diameter steel messenger wire by independent loop hangers spaced 15 ft. apart and alternately connected to each contact wire, a double pan collector ensuring sparkless collection from the twin trolley wires. Porcelain insulation is used throughout and steel poles support brackets carrying the messenger and also brackets carrying the feeder and return wires. The accompanying illustration of a section of the overhead construction shows the alternate hanger system suspending the wires from the messenger, also the feed and return with a "Tee" feed to the wires. The construction is sectionalised as a protection.

Concealed bonds are used on the track and special fish plates are installed throughout the section.

The traction motors are of the commutating pole type with air inlet at the top and ready access to the armature, pole pieces, and field coils through the pinion end. They are designed for operation at 1,000 volts and are used three in series at 3,000 volts. Each motor is rated at 258 h.p.

Electro-pneumatic control is practised and the connections provide for one group of six motors in series, or two groups of three motors each in series. Fourteen steps are provided for acceleration with six motors in series, ten steps with two parallel groups of three in series, and thirteen steps in regenerative braking. In starting, the six motors are connected in series with the line and an adjustable resistance. Sections of this resistance are short circuited as the controller is moved from point to point over the series travel of the main handle until all the resistance is out and the six motors are in series directly across the line. A pneumatically-operated transfer switch reconnects the motor circuits in the series-parallel arrangement. All the switching is performed by air-operated contactors which short-circuit the resistances. They are closed by air pressure, and opened by the action of a heavy spring. An electro-pneumatically-operated reverser is interlocked with the line contactors.

For speeds above the full series and full parallel connection, two reduced-field positions are provided by means of which the motor speed is increased.

Regeneration is accomplished by using one motor for exciting its own field and the fields of the other five motors. The regenerative braking employs the same controller, contactors, and resisters as are used during motoring, thus simplifying the control.

Power for the auxiliary supplies, control circuits, lighting, heaters, air compressor, exhausters and battery charging, is supplied by a 10-kW, 65-volt generator direct coupled to a 3,000-volt motor, the shaft also carrying the blower used for the ventilation of the motors and apparatus.

The section of railway referred to is nearly 40 miles in length and passes through 71 tunnels, with an aggregate length of about 17 miles, most of which are on curves, one turning through about three quarters of a complete circle.

French Electrical Industry.

WE have already referred in the ELECTRICAL REVIEW to the great expansion that has taken place in the electrical manufacturing industry in France during recent years. The subject is referred to by Dr. Wolf, in an article in the *Oesterreichische Volkswirthschaft*. He states that production has risen from about 200,000,000 fr. in 1913, to 1,500,000,000 fr. in 1923, but, of course, allowance must be made for the inflation of prices. This is demonstrated by a comparison of the tables appearing below.

While the imports after the war, under the spur of a general lack of goods, almost doubled, in 1922 they had fallen considerably; on the other hand, the exports since 1921 have steadily risen, and in 1923 they were 67 per cent. higher than in 1913 (taking weight only), the excess of exports over those of 1913 being threefold. For German development this means a great loss, for, apart from the fact that the French outlet, which formerly was very considerable, is now lost, Germany has now a competitor in France in foreign markets.

TABLE I.

	Imports.		Exports.		Excess of Exports.	
	Tons.	Mill. fr.	Tons.	Mill. fr.	Tons.	Mill. fr.
1913	7,600	31	10,000	34	2,400	3
1920	13,754	282	14,240	260	486	—
1921	12,241	163	12,432	212	191	49
1922	8,411	118	13,000	198	4,589	80
1923	8,894	154	16,716	270	7,822	116

Table II shows the distribution of trade in the various items of electrical goods in the first seven months of 1924:—

TABLE II.

	Imports.		Exports.	
	Tons.	1,000 fr.	Tons	1,000 fr.
Glass and porcelain	907	6,051	1,901	8,869
Glow and arc lamps ...	301	26,849	242	10,414
Parts of electrical machines and apparatus	424	9,827	604	13,651
Electric motors	1,585	31,681	2,359	33,991
Electrical apparatus and appliances	840	31,774	3,008	117,539
Accumulators	342	1,866	458	3,146
Wire and cable	70	1,765	2,006	21,714
Total	4,478	109,813	10,578	209,144

The writer considers that the future for the French electrical industry is equally bright. There are water resources of about 10,000,000 h.p. waiting to be harnessed. The capacity of the electricity generators at work in French stations grew from 1,400,000 kW in 1921, to 2,600,000 at the end of 1923; at the same time the length of network advanced from 23,000 to 70,000 km. The number of consumers of electricity totalled 24,000,000 in round figures. The capital invested in generation and distribution amounted to 35 milliard francs. On July 19th, 1921, a Government decree outlined the formation of a network to embrace the whole land. The electrification of the railways is being actively prosecuted. The law of August, 2nd, 1923, empowered the Government to loan 600,000,000 fr. on favourable terms to rural organisations in aid of electricity supply systems. The number of such organisations in 1913 was 4,000, which figure has since risen to 10,000, the advance in this period being equal to 20 per cent. The spread of electrification in the country generally likewise increased during 1924. From the facts quoted by the author, he deduces that the steady development of the use of electricity must afford an ever-broadening and remunerative future for the electro-technical industries.

Electrical Trade of Austria and Hungary.

THE Austrian and Hungarian Governments are now issuing statistics which afford an interesting view of the progress of the electrical trade of the respective countries since the reconstruction measures. Below are given the weights and values in the first six months of 1923 and 1924, respectively, of electrical machinery, apparatus, and accessories imported into Austria, together with the proportion of electrical machinery contained in the totals, and the shares of the principal supplying countries this year.

IMPORTS.

	(First six months.) 1923. Quintals. (100 kg.)	1924. Quintals. (100 kg.)	1923. Thousands of gold crowns.	1924. Thousands of gold crowns.
Electrical machinery, apparatus, and accessories (total)	20,474	15,506	5,997	6,748
Including electrical machinery	4,239	3,875	1,590	1,530
From Germany	—	—	—	5,510
„ Switzerland	—	—	—	187
„ Czecho-Slovakia	—	—	—	488
„ Hungary	—	—	—	416

About 24 gold crowns are equal to £1. In comparing the foregoing totals with those which follow, it will be seen that Austria is already exporting again more than twice the value of electrical goods that she imports, in spite of the large quantities of material needed for her power and traction developments.

EXPORTS.

	(First six months.) 1923. Quintals.	1924. Quintals.	1923. Thousands of gold crowns.	1924. Thousands of gold crowns.
Electrical machinery, apparatus, and accessories (total)	40,323	38,680	17,000	15,410
Including electrical machinery	14,443	9,635	5,150	3,710
To Germany	—	—	—	1,577
„ Italy	—	—	—	1,165
„ Poland	—	—	—	1,191
„ Rumania	—	—	—	1,324
„ Jugo-Slavia	—	—	—	2,222
„ Czecho-Slovakia	—	—	—	1,693

It is evident that Austria's chief customers are found amongst her near neighbours and former close connections.

The classes of goods comprised in the foregoing totals for the first half of 1924, together with the shares of the principal countries of origin or destination are shown in the following table:—

	(First 6 months 1924.) Imports. Quintals.	Exports. Quintals.
Dynamos and motors	1,551	7,084
Including Germany	1,146	179
„ Rumania	—	1,412
„ Jugo-Slavia	1	1,554
„ Czecho-Slovakia ...	60	625
„ Hungary	252	858
Dynamo and motor parts	1,449	272
Dynamos and motors coupled with other plant	127	231
Static transformers	700	2,030
Including Germany	570	16
„ Poland	—	697
„ Switzerland	117	—
„ Jugo-Slavia	2	423
„ Czecho-Slovakia	1	338
„ Hungary	10	200
Telegraph apparatus	62	38
Telephone apparatus	90	1,123
Meters and instruments	793	1,611
Incandescent lamps	1,128	8,534
Including Germany	938	1,863
„ Great Britain	1	572
„ Italy	—	845
„ Hungary	173	18
„ United States	—	809
Heating and cooking apparatus ...	58	264
Electrical apparatus, unspecified ...	4,342	5,363
Insulated wire and cable	272	8,359
Including Germany	112	135
„ Great Britain	—	893
„ Italy	138	112
„ Poland	—	960
„ Rumania	—	1,153
„ Jugo-Slavia	—	2,872

For Hungary, figures covering nine months are available. The quantities imported and exported this year and last year compare as follows, the proportions respectively of machinery and lamps being shown, together with the values in gold crowns during January to September, 1924:—

IMPORTS.

	January to September. Quantity. 1923. Quintals.	1924. Quintals.	Value. 1924. Thous. gold crowns.
Electrical machinery and apparatus	6,344	7,774	2,542
Including dynamos & motors	2,720	4,634	908
„ electric lamps ...	514	432	186

EXPORTS.

Electrical machinery and apparatus	23,881	28,196	12,114
Including dynamos & motors	10,070	11,089	2,251
„ electric lamps ...	7,815	10,904	6,683

It will be noticed that both imports of dynamos and motors and exports generally show healthy increases. The principal items making up the totals during the nine months of the current year, together with the main countries of origin and destination are shown in the following table:—

	(January—September, 1924.) Imports. Quintals.	Exports. Quintals.
Dynamos, transformers and parts ...	4,635	11,000
Including Austria	1,920	2,032
„ Rumania	84	1,327
„ Germany	1,677	239
„ Italy	104	3,247
„ Belgium	6	1,806
Telegraph and telephone apparatus ...	229	1,510
Including Rumania	—	732
„ Jugo-Slavia	—	320
„ Germany	94	—
„ Belgium	94	—
„ Bulgaria	—	418
Instruments and meters	428	1,508
Including Austria	110	28
„ Germany	306	51
„ Italy	—	797
Switches, contacts, &c.	482	881
Incandescent lamps	432	10,904
Including Austria	48	1,254
„ Czecho-Slovakia	33	1,060
„ Germany	345	1,434
„ Italy	—	770
„ Belgium	—	918
„ United States	—	2,315
Insulated wires and cables	196	1,005
Including Germany	104	165
„ Rumania	—	530
„ Great Britain	—	176

By-Product Hydro-Electric Power.

Californian Agricultural Storage Projects.*

THE art of building high dams has made available a new source of power—a by-product of the release of stored water to satisfy an irrigation demand—that has characteristics peculiar to itself, most important of which is the remarkable way in which the output curve follows the demand curve of adjacent irrigated areas requiring power for pumping. The ultimate amount of power that will be available from such plant will govern the agricultural development of areas which would be without water supply if it were not for this relatively cheap and abundant source of power for pumping. Mr. E. N. Bryan, Office Engineer, Div. of Water Rights, Dept. of Public Works, California, presents some of the unusual problems in the marketing of this power toward the solution of which little progress has yet been made, and mentions some of the dangers connected with this type of development which should be recognised and guarded against.

Although in the operation of irrigation storage reservoirs so as to deliver considerable hydro-electrical energy, purely as a by-product, the United States reclamation service was the pioneer, the first plant to be constructed in California was that recently completed at Don Pedro on the Tuolumne River by the Modesto and Turlock irrigation districts and certain peculiarities of this power plant places it in a class apart from all other installations. American engineers of the U.S. Reclamation Service have built several dams well over 200 ft. in height, one of which, the Arrowrock Dam on Boise River in Idaho, has a total height of 348.6 ft. Now they are proposing a dam at Boulder Canyon on the Colorado River which would tower 735 ft. It is improvement in the design and construction of high dams which has made possible the huge agricultural storage reservoirs which will deliver hydro-electric power as a distinct by-product—purely incidental to the operation of the storage works for the benefit of the lands to be irrigated and the relatively small proportion of the total cost actually incident to the power development tends to exert a

* From *Proceedings* of the American Society of Civil Engineers; January, 1925.—*Abstract.*

peculiar influence on the output. The Turlock Irrigation District (California), proposes that $2,570,000 be expended on the Don Pedro Dam and only $1,028,000, or approximately $23 per h.p., on the power system.

Ordinarily, the power plant is located at (or near) the storage dam, in which case all (or nearly all) the cost of producing the head on the turbines may be charged against the agricultural storage so that the unit cost of the power installation becomes very low. It makes little difference in the total cost of the project, therefore, whether the power installation is for a 40, a 50, or a 60 per cent. load factor, and this, in turn, has a marked influence on the possible output curve of the power plant, which takes on the peculiar characteristics of the demand curve of the irrigated area to be served with the stored water. The curves are parallel and similar except that the peak of the irrigation demand is not reached until shortly after the peak of the power output has passed. They do synchronise to such an extent, however, that in cases of equal installed horse-power 77 per cent. of the gross annual power output becomes available when and as needed for irrigation pumping. An additional 5 per cent. of the total power output becomes available at a time when, under normal conditions, it will be most easily absorbed into the general power market to replace stand-by power generated by steam or otherwise. To the extent that the power output curve of the by-product plant falls below the irrigation demand curve in May, June, and July, this demand for peak power for irrigation pumping can most readily be taken care of by the ordinary hydro-electric plant supplying the general market, because such plant can then generate a maximum.

The importance of this type of development is often underestimated. The installation recommended for the Melones project on the Stanislaus River is 32,000 h.p. The Don Pedro Project on the Tuolumne River now has three 5,000-kVA sets installed, with provision in the dam for the addition of four more similar sets, giving a total capacity of about 45,000 h.p. At Exchequer, on the Merced River, plant is now being constructed which will have a capacity of 32,000 h.p. Plans are in preparation for a project at Pine Flat on the Kings River of 65,000 h.p., or more. Numerous other similar projects are in contemplation in California at present, and an installation of about 1,000,000 h.p. is practical at the proposed Lees Ferry dam on the Colorado River, and 4,000,000 continuous h.p. can be developed in the 670-mile stretch of the Colorado River between the Town of Green River, Utah, and Boulder Canyon, a short distance above the California line.

For normal years the annual output of the plant in the San Joaquin Valley is estimated as follows: Melones, 109,000,000 kWh; Don Pedro, 185,000,000 kWh; Exchequer, 120,000,000 kWh; and Pine Flat 200,000,000 kWh. These are only four of six similar sets of plant proposed, but their combined output as estimated is 614,000,000 kWh, which is almost three times the electrical energy consumed for agricultural purposes in the whole of the valley from Bakersfield to Stockton during 1923.

The ultimate total delivery of power by by-product plant is relatively very important. The supply is adapted especially to the satisfaction of a demand for irrigation pumping. In the case of three large projects with an abundance of water, the proposed ultimate installation is equivalent to that required for an irrigated area of equal size with an average lift of 90 ft. This by-product would appear to open the way for the irrigation of lands not heretofore thought susceptible of irrigation because of the cost of power.

The marketing of the by-product presents some unusual and as yet unsolved problems. At least three means readily present themselves: (*a*) the power might be sold wholesale at the generator switchboard to a utility concern, which might bear the cost of stand-by service, of distribution, and of collection of accounts, and, therefore, be able to afford to pay only a relatively small part of the average rate paid by the actual consumers; (*b*) the producer might undertake himself to bear the cost of stand-by service, distribution and collection of small accounts, and might then expect a much higher average rate; and (*c*) the project area might be increased so as to include a demand for a considerable block of the by-product power for irrigation pumping, thereby distributing the capital cost of the project over a larger area, and leaving for outside sale a much smaller block of surplus power. Neither the cost of producing nor precedent establishes the sale value of such power; and the conditions which govern it are not generally understood.

Certain dangers connected with this type of development should be recognised and guarded against, such as false encouragement of premature and ill-considered irrigation development; the waste of water through low-head power plant along the lower reaches of the river, which water may be needed for irrigation and power development on the upper river; the destruction of capital by duplication of existing systems; and the lack of some disinterested regulative authority to stand between producer and consumer in the matter of rates and service.

New Electrical Devices, Fittings, and Plant.

Readers are invited to submit particulars of new or improved devices and apparatus, which will be published if considered of sufficient interest.

"Helsby" Colliery Lighting Fittings.

Among the fittings designed by the BRITISH INSULATED AND HELSBY CABLES, LTD., for use with its colliery-lighting system are those illustrated in figs. 1 and 2.

The first is an angle fitting for use with vacuum-type lamps.

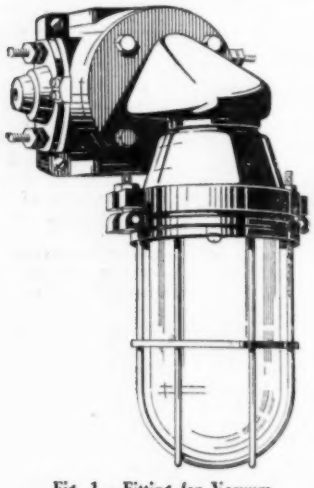


Fig. 1.—Fitting for Vacuum Lamp.

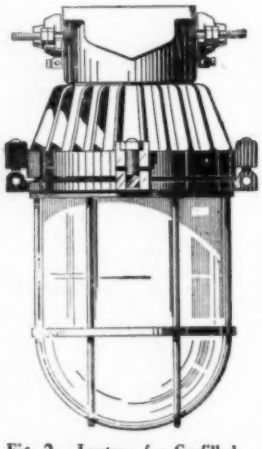


Fig. 2.—Lantern for Gasfilled Lamp.

It consists of a standard junction box, in which the connections are made by means of detachable brass connecting pieces which are mounted on a central stud and rigidly clamped between insulating bushes, and a substantial cast-iron bracket which has a machined flange to fit the top of the junction box. To this bracket a guarded well glass is fitted.

Fig. 2 illustrates a fitting designed especially for gasfilled lamps, and accordingly is provided with a heat-dissipating arrangement in the form of a number of large radiating fins on the lantern top. From a series of tests made with a 100-W gasfilled lamp it was ascertained that the maximum temperature rise within the box was less than 40 deg. F.

A Tramcar Sanding Gear Heater.

During wet and cold weather it is difficult to keep the orifices of sand pipes fitted to tramcars, locomotives, &c., dry so that the sand will not adhere to the inside of the pipe and eventually choke the outlet. A device which prevents such trouble has been designed by Mr. C. B. Johns, and is said to have functioned well on the American railways. It takes the form of an electric heater that is simply screwed on to the end of the sand pipe; in the annular space between the casting and the pipe is sufficient space to accommodate a few turns of insulated wire coiled round the pipe. By passing current through the coil the pipe is sufficiently heated to keep it dry under all weather conditions, thus ensuring a good flow of sand for securing full tractive effort and maximum adhesion for braking. The UNIVERSAL SAND PIPE HEATER CO., 1536, Commercial Trust Buildings, Philadelphia, Pa., U.S.A., manufactures the heater in 64- and 80-watt sizes.

The Garnier Meter.

The "Compteur Garnier" is an electricity meter manufactured by APPAREILS ELECTRIQUES ET COMPTEURS GARNIER, 23, Rue Cavenne, 25, Lyons. It is a compact meter of simple design, and can be made for a.c. work in sizes to carry up to 35 amps., 600 volts, and for frequencies of from 25 to 100 cycles. The whole of the mechanism, including the current and pressure coils, is mounted on a frame so that it can be withdrawn from the meter base by releasing two screws. The load and light running adjustments are made by the usual brake magnet and shading pole methods, respectively, and the registering train gear is of the cyclometer type. The makers claim that the running losses are below 0.003 of the maximum load, and that the shunt losses are 0.9 watt at 110 volts.

Time Switches at West Ham.

In connection with the conversion of street lamps, gas to electric, at West Ham, some fifteen months ago, the Electricity Department, designed, in co-operation with VENNER TIME SWITCHES, LTD., a novel combination of time switch and fuse box. The special feature of this is the method adopted

Fig. 3.—Front View of Time Switch.

to prevent access of ground damp to the time switch. As is well known, ground damp, especially in made-up ground, is very acid in character and, therefore, makes a strong attack on brass and copper work, even in hand switches. Where clocks are concerned, protection against this is, of course, of supreme importance—of much more relative importance, in

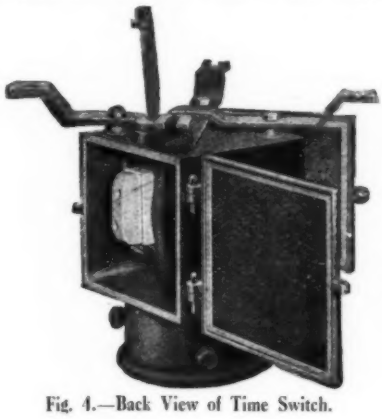


Fig. 4.—Back View of Time Switch.

fact, than protection against rain, although the latter is by no means to be neglected.

The box has a partition down the centre, with the entrance and exit holes for the cables on the fuse side only. The incoming cables come to the fuse terminals, whence connections are taken through the partition to the switch and, finally, on the fuse side of the partition, up to the lamp. The time-switch side of the partition is thus a closed box with no holes communicating with the lamp-post or the lantern.

Only a single-pole fuse, of the "Revo" type, is used, but there is plenty of room for a second fuse, if thought advisable. The time switch, as is usual in this small size, is arranged to plug in, so that the clock can be oiled or repaired without disturbing the connections, by withdrawing it from the box.

The illustrations (figs. 3 and 4) show front and back views of the box which, it will be seen, has a collet at the bottom for bolting to the lamp-post, and frogs at the top to take the converted gas lantern.

The box and general arrangements were designed, and the whole work of conversion carried out by the West Ham Electricity Department.

A Magnetic "T"-square.

AXENE, LTD., Maxwell House, Arundel Street, Strand, W.C.2, draws our attention to a novel device which it is marketing. This is a "T"-square which holds on to a drawing board—a thing which is often desired by the user of the ordinary "T"-square. Of course, this has already been

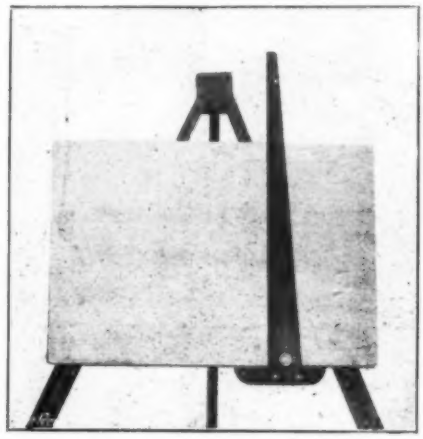


Fig. 5.—A Magnetic "T"-Square.

done mechanically, but in the present instance the head of the square is a cobalt-steel magnet which engages with steel strips let into the edges of the drawing board. As is well known, cobalt steel has remarkable retentivity of magnetism, and it is claimed that the "T"-square, with ordinary use and care, will retain its properties almost indefinitely. The illustration, fig. 5, shows the square in a "head-downward" position.

Another refinement introduced in the design of the "T"-square is the bevelling of the lower edge enabling the heads of drawing pins to be passed over easily.

The Design of Electrical Control Gear and Connections.

Protection Against Shock, Fire, and Faults.

By H. W. CLOTHIER, M.I.E.E.

(*Abstract of paper read before the* INSTITUTION OF ELECTRICAL ENGINEERS.)

THE paper discusses means of preventing risks to life and plant, and endeavours to collate present practice and to ventilate some demands which are in a nebulous stage, including the meaning of the breaking-capacity rating of circuit breakers.

To avoid shocks it must be impossible for a person to make accidental contact with, or to come within arcing distance of, a live conductor. The ideal, then, is to enclose every conductor so as to render it inaccessible when alive, and a further condition for safety is that the enclosure must prevent the forceful extrusion of gases and flame. Prompt automatic isolation of the faulty section of plant by efficient discriminating systems of protection is an essential in limiting the extent of injury to property. The stability of sound parts during a heavy fault disturbance is frequently jeopardised by a demand for relay settings which are unnecessarily sensitive, i.e., the operating setting is lower than one which would prove to be a real menace to the continuity of supply.

The principle of metal enclosure has been well evolved in the general designs of alternators, motors, and other rotating plant. More often than not, however, the proper finishing off of the metal enclosure has been neglected at a most critical place, namely, at the terminal ends of the stator windings. A solid type of metal-clad fitting, providing at the same time a sealing box for the cables, is appropriate at this position.* Placing transformers out of doors has been an extra inducement to complete metal enclosure. Sealing end-box insulation has required special research owing to the high temperatures at which it is permissible to run this form of plant on load. Moreover, transformer oil is very penetrating. The enclosure of reactances when immersed in oil tanks can be dealt with in the same way as that of transformers. Reactances in the form of coils of lead-covered cables embedded in a concrete block with ends finishing in metal terminal boxes are truly metal-clad,† and throughout the layout of plant, therefore, the principal requisite for complete and continuous enclosure consists in a carefully designed connection between the ends of the metal-clad cable and the metal enclosure. Although intervening switchgear conductors have provided the biggest obstacle, British metal-enclosed switchgear is now available to surmount this. Metal-clad "draw-out" gear has been made in three general classes:

* Woodhouse and Melton, Yorkshire Electric Power Co., Ltd.
† Beard.

(1) Horizontal isolation (the author); (2) upward isolation (the author); and (3) downward isolation (Erskine, Heap). Bus-bars are compound filled (Highfield).

The amount of duplication should be governed by the liability to breakdown. The metal-clad enclosure of all conductors certainly does reduce the possible extent of switchgear breakdowns, thanks to its unit form and to the metal shell which must tend to localise the disturbance and prevents the spread of arcing. It is better economy to increase the initial expenditure in obtaining quality and strength of parts, thus

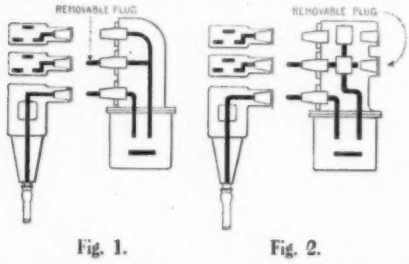


Fig. 1.

Fig. 2.

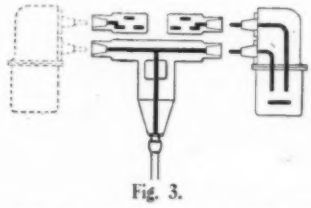


Fig. 3.

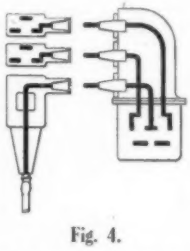


Fig. 4.

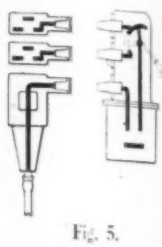


Fig. 5.

tending to make them immune from failure, than to duplicate such parts; one good circuit breaker is better than two of inferior quality—it engages less attention and maintenance, to say nothing of the saving in initial outlay for housing. The draw-out feature has been shown to be a good substitute for duplication, in so far as it furnishes a ready means of inspection in safety and of the substitution of one circuit breaker for another at short notice.

On a few occasions during the life of the plant the duplication of bus-bars may be advantageous; for example: (1) When

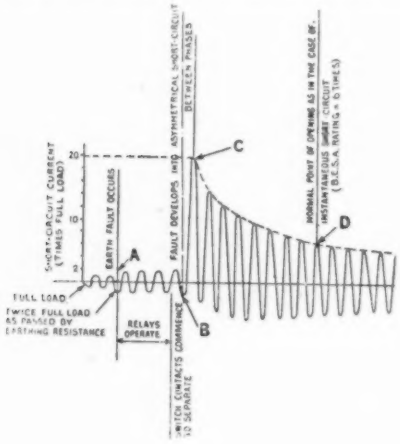
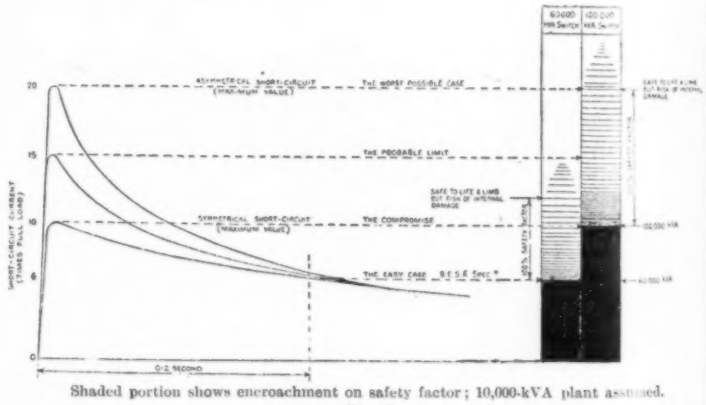


Fig. 6.



Shaded portion shows encroachment on safety factor; 10,000-kVA plant assumed.

Fig. 7.

running up a new or doubtful machine on an independent circuit or test-circuit; (2) when making extensions one bar may be made dead at a time; (3) for cleaning purposes; 4) in case of breakdown of switchgear. The metal-clad form eliminates items (3) and (4).

The change-over from one circuit to another is always more or less risky. Many serious accidents and shut-downs have occurred due to the faulty opening of bus-bar selector switches whilst carrying load on open-type switchgear; and so, from the earliest in metal-clad power station switchgear care was taken to remove this danger by making it impossible to change circuits over when on load. The hood of the circuit breaker was fitted with two sets of plug sockets, corresponding to the top and bottom bus-bars, and one set of plugs. Access to the change-over plugs can only be obtained by first withdrawing the circuit breaker carriage (fig. 1). To be able to make the change-over without having first to open the circuit on the oil circuit breaker has recently been claimed to be an advantage, and several methods have been investigated. One proposal (fig. 2, Christianson) consists of enlarging the hood and withdrawing the plugs from the front of the switch, interlocks being provided that will allow both sets of plugs to be "in" at the same time when the bars are in parallel; no portion of the live plug is accessible during the process of withdrawal. Other plans involve the use of two circuit breakers suitably interlocked (fig. 3), a double-contact breaker (fig. 4, Ferguson, Pailin), and the substitution for the plugs of a set of change-over switches immersed in oil or a semi-fluid insulating compound within the hoods on the circuit breaker (fig. 5). The coupling switch joining the bus-bars must be closed and cannot be opened until the change-over has been completed. Sometimes a coupling switch must be installed only for this purpose, involving considerable extra expense. To open the circuit before changing over is the safe way, and is more simple in design. The need for changing over whilst the circuit is alive is often more imaginary than real.

The separate phase enclosure in metal-clad switchgear is, as a general rule, only adopted where heavy duty and comparatively high voltage make it advisable. The multi-phase enclosure of bus-bars, instrument transformers and connections sealed in compound is quite sufficient for stations in which the aggregate full load is below 100,000 kW, or in which the pressure is below 40,000-50,000 volts. The practice in this respect is somewhat analogous to the respective use of 3-core or single-core cables. The likelihood of an internal fault is remote, but should one occur the arc cannot be long or sustained, because it is confined to the earthed metal in its own close vicinity. It is not so with the cellular switchgear, and in some of the largest stations in the world the phase separation has been carried out to the extent of providing what is virtually a separate building for each phase. Experience has shown that even with this extreme precaution a fault can spread from one phase to another and from one circuit to another.

For complete phase separation with metal-clad switchgear the bus-bar chamber is divided into three compartments, earthed metal surrounding each phase. The isolating switches, circuit breaker, current transformer, and single-phase potential transformer, and all connections down to the cable dividing-box, are in separate phase enclosures. The principle may be extended by using single cables for generator and transformer leads.

The enclosure of the circuit breaker is a large factor in determining the breaking capacity; the majority of failures have been the result of weakness in the tanks and top plates. In the case of metal-clad gear in ordinary industrial service the circuit breaker has been more economically and conveniently arranged in one tank than in three separate tanks. Metal divisions inside the tank surrounding three sides of the sparking contacts, for a breaking capacity above 100,000 kVA, eliminate the risks of arcing between phases and strengthen the tank.

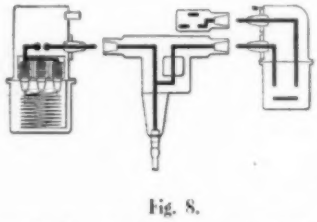


Fig. 8.

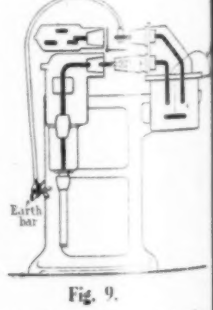


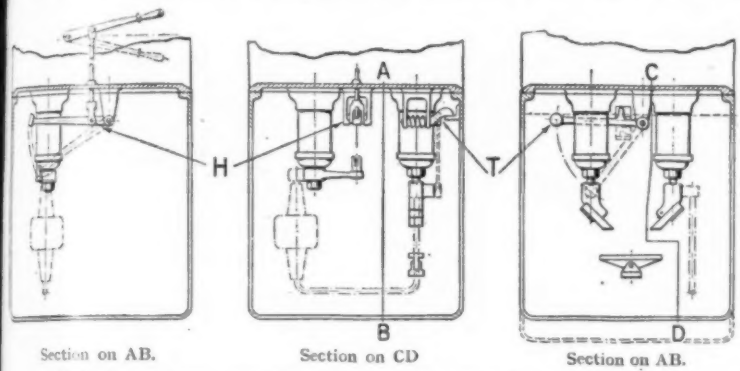
Fig. 9.

The B.E.S.A. definition of the breaking capacity of an oil-immersed circuit breaker explains fully that the current on a severe short-circuit will reach temporarily a high value, but that "due account" should be taken of reduction in the current to be broken as affected by the time characteristic of the circuit breaker and relays. With this easement a generator circuit breaker may be rated at six times the total kVA load of the generator (10 per cent. reactance in short-

circuit), although it is admitted that under a combination of the worst conditions on the same circuit as much as 20 times the current may have to be broken. Between these two values there is much room for speculation as to what the kVA rating of any circuit breaker really means in relation to satisfactory service on a specific size of plant. Is the 50,000-kVA power station to have 60,000-kVA or 200,000-kVA circuit breakers?

Performances of circuit breakers have had in the main to be gauged from experience in places where they have been overloaded under short-circuit conditions. In such situations comparatively small circuit breakers have satisfactorily cleared faults of much larger value than that for which they were originally intended, but when fixing commercial ratings a due margin for safety had to be made to cover the unfavourable hazards also met with in practice.

The introduction of reactance does not necessarily reduce the arc energy with which the circuit breakers have to deal in clearing short-circuits from the system. In fact, in some



Section on AB. Section on CD Section on AB.

H=hand-operated earthing contacts. T=tank-operated automatic earthing contacts.

Fig. 10.

cases the stress experienced on the breaker has been actually greater, due to the reactance, notwithstanding the reduced current value. It has also to be borne in mind that if the fault (it may be a high-resistance fault or a fault to earth culminating in a dead short-circuit) starts at A (fig. 6), the sparking contacts may separate at any point from B onwards; at the worst, in rare cases, it might be at C when the breaking capacity is the maximum, *viz.*, 20 times full load. If it is an instantaneous short-circuit, the contacts would separate in most cases about D, where the kVA on the B.E.S.A. basis would be six times full load.

In any case the circuit breaker must be designed to withstand the mechanical forces and impulses given by the current at C. It should also break circuit at this stage at least without danger to persons or neighbouring plant, although it might in such exceptional circumstances require some attention before being put into service again. Moreover, the specification recommends that as the current to be broken "is limited by the reactances and resistances in circuit," the rating of the circuit breaker may be reduced in proportion. This seems to be in conflict with the experience that in circuits carrying equal current additional reactance increases the arc energy, and so at present the breaking capacity may not truly represent the work that the circuit breaker has to do in breaking the circuit. The way to rate any article is to base its performance upon some unalterable standard. It would therefore be a better guide, in stating the breaking-capacity rating of a switch, to qualify it by stating the basis in terms of generating-plant output and reactance on short-circuit.

A suggested compromise is to rate circuit breakers as being perfectly efficient at the maximum symmetrical current, *viz.*, 10 times the aggregate full load, but admitting encroachment upon the design safety-factor at the exceptional asymmetrical current up to 20 times full load (fig. 7). If this were the understanding between the buyer and the maker it would only remain, in selecting the required size of breaker, to make allowance for any deviations from the standard circuit in inductance, resistance and capacitance, appertaining to the position and circumstances of the circuit on the system. A generator circuit with more inductance than the 10 per cent. internal reactance on short-circuit may require greater breaking capacity, and a distant non-inductive circuit less than the standard, for equal short-circuit currents. The exact adjustment is a matter for experience and research.

The "through" rating of a circuit breaker may be defined as "the maximum current that the circuit breaker will carry during the transition period of a fault current without deformation of any parts of the circuit breaker, burning of contacts, or other forms of permanent injury." Any circuit breaker should be capable of carrying the maximum "through" current possible in its situation on the system for at least 1 second in order to provide a margin for safety in the duration of a through short-circuit for ½ second. For power station service a high "through" rating current is required of not less than 100 times the normal current-rating of the generator switchgear panels, assuming not more than 10 generators of 10 per cent. reactance. At such ratings the conductors must all be so arranged that the magnetic forces improve the current-carrying capacity of the contact surfaces. But as there are other deforming causes than temperature, for instance, strains on conductors due to magnetic causes, the thermal characteristic is not the only one, and the term "through" rating would appear to be more expressive.

On an all-solid system where the duplicate bus-bar is rarely (if ever) used, it might be made to serve the dual purpose of "hospital" and reactance tie bus-bar, thus saving the initial and upkeep expense of the separate reactance plug-gear and bus-bar.

The use of a reactance is apt to complicate the layout and operating conditions. It is preferable to employ, throughout the system, circuit breakers competent to act without artificial inductance, that is, other than that inherent in the cables, transformers, and generators. The economy in being able to lay out and run the network without having to think when, or when not, to put in reactances is an item which can be balanced against the possible extra initial cost of the switchgear. Moreover, as stated above, the fact that although inductance reduces the fault current and mechanical forces, it does not necessarily reduce to the same degree the energy dissipated in the arc, and consequently the performance of the circuit breaker must not be overlooked.

It is sometimes difficult to understand the need for the very expensive lightning arresters installed in other countries, as compared with the experience in this country. It is true that higher voltages are employed, but the insulation should be better able to withstand the excess-voltage conditions. It is probable that lightning has been made a scapegoat to explain away many failures which in reality have been due to inferior insulation at the start. A high-frequency surge may be (1) absorbed upon the line itself or (2) allowed to discharge to earth. Where cables can be laid in series with the overhead lines, the excess voltage is absorbed in the capacity of the cable, and, with a high standard of insulation, satisfies the conditions prevailing in this country. In one design on metal-clad lines the discharge is made over a number of narrow air-gaps formed between flat surfaces in a pile of copper disks, the flow of power current being limited by a resistance immersed in oil. The whole device is mounted in a metal-clad carriage which is plugged into the switchgear orifice (fig. 8).

The method of earthing at the end of a line on which men are going to work is indeed a matter of life and death. Without exception the final closing of the earth connection should be done within an oil-filled enclosure, for example, on the contact of a circuit breaker. Then, if any mistake

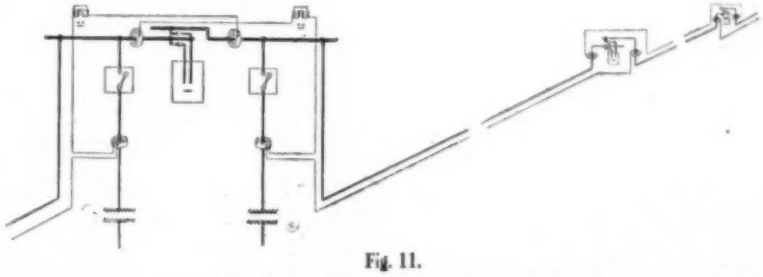


Fig. 11.

is made, it will be no more serious than closing on a fault, and it may be limited to a single-phase fault to earth if a trial is made on one phase only at first. Fig. 9 shows an assembly of plug contacts, terminals, and earthing cable, which serves this object. In another design a hand-operated earthing contact is included as a component in the oil-immersed isolating switch; this is shown in fig. 10, which also shows a convenient means of earthing automatically and simultaneously with the lowering of the switch tank (F. Coates and Mirrey).

The cutting down of strength and qualities of designs and materials on important switchgear is doubtful economy. The cuts should be restricted to reducing the required number of functions, appliances, and constructional features. For example, an oil switch-fuse* combined with a transformer to form a small outdoor sub-station will take the place of switchgear panels, transformer, and connections in a building. The single-switch sub-station scheme† reduces the number of switch panels required in the ring main (fig. 11). At the same time it provides for the automatic isolation of a faulty section

* Gregory (Electrical Improvements, Ltd.).
† Beard (Electrical Improvements, Ltd.).

in the ring without discontinuing the supply to the other consumer. In this case the cable and power transformer are linked together in protection under the voltage-balance system by means of a "tee." The fuse arrangement acts also as a hand isolating-switch.

(To be concluded.)

Discussion in London.

Mr. E. B. WEDMORE opened the discussion by saying he could not go the whole way with the author, who carried some of his suggestions too far. Notwithstanding good buyers and good maintenance, switchgear repair bills still ran into millions which seemed to indicate that something was bad somewhere. Duplication of switchgear had its advantages, but was it right to put all the essential plant in such a small compass so that if anything went wrong it would mean serious and prolonged delay? The energy released by a switch under identical conditions might be many times greater at the second time of operation than the first, and it seemed that a switch must be tested at least six times before an idea of its rupturing capacity could be obtained. In protective gear finality had by no means been reached; when the Hunter system was invented they all "kicked themselves for not having thought of it before," and the younger engineers would find it profitable to apply themselves to the subject seriously. It ought to be possible to evolve a method using one pilot wire only in the middle of the cable.

Dr. C. C. GARRARD congratulated the author on his enunciation of the "stability ratio," which was of such extreme importance that he would suggest the Standardisation Committee getting to work on the matter as soon as possible. He agreed with the author's preference for the term "mistake-proof" rather than "fool-proof"; it was necessary to guard the operator who had to act quickly in emergency and was liable to make a mistake the same as anyone else. Complicated interlocking arrangements in a large station were to be deprecated, because they imparted a false sense of security. It should be a rule for all joints on a switchboard to be inspected once a month as they were apt to become loose. The losses in lead-sheathed reactances as described in the paper would probably be greater than those in the open type. In deprecating the duplication of bus-bars the author could hardly be serious and fig. 7 would do harm to British manufacturers; all that the B.E.S.A. specification of the breaking capacity of circuit breakers did was to give the manufacturer a lead. He was unable to understand what the author intended to convey by the term "through rating" of a switch and objected strongly to his suggestion that the final earthing of a transmission line should be made through an oil switch. The remarks in the paper regarding the use of reactance should be read with caution, because in large stations reactance was necessary. He did not know that turbines vibrated.

Mr. W. A. CHRISTIANSON felt that complete enclosure of gear was highly desirable, although he pointed out that when faults did occur on metal-clad gear they could be lasting, and serious under certain conditions. Changing over from one bus-bar to another should be done quickly, but the best method of carrying out the operation was a matter for the decision of operating engineers. With the aid of a lantern slide diagram he showed what he claimed to be an improved circulating-current protective system.

Mr. P. ROSLING said that the author's suggestion that direct lighning strokes and surges in overhead lines should be dissipated in the cable portion of the line would, it was true, save the transformers, but that sort of procedure was rather rough on the cables. It was a question of how often the cables would have to act as surge arresters, as repetition localised the stress. The fern or tree markings often noticed in cable that had failed seemed to be an indication of some such action breaking up the electrons in the matter of the insulation; therefore, when the cause of breakdown was not obvious it would be worth while installing arresters to take care of any pressures above the working voltage.

Mr. H. TRENCHAM said that the author had done a great deal of very sound work, and he (the speaker) agreed with the fundamental ideas outlined in the paper. The principle of the "explosion-box" circuit breaker was not completely understood and he looked forward to the time when investigation would have shown just what did happen when such a type of breaker operated. Some of the circuit-breaker tests in this country had been carried out with comparatively small short circuits; it was desirable to test with currents approaching more nearly to those realised in practice. With regard to protection, biasing was correct practice and he would say that they should bring to the relays only those tripping forces that were necessary for their correct functioning.

Mr. K. EDGCUMBE wanted to know why the earthing resistance should be done away with, and pointed out that he knew of a case where a cable had failed again and again until a surge arrester was installed.

Mr. H. W. CLOTHIER, in replying to the points raised, said, with regard to the recent production of metal-clad switchgear by other manufacturers, that competition was good in a way; moreover, it was his opinion that metal-clad gear was destined to make British producers stand out in the world. He did not admit the necessity for duplicate switches; the best quality of metal-clad gear with the best possible numbe of pieces was much preferable to large spaces in lar buildings. If one unit of the former type failed the ne adjacent would be unaffected, whereas with the latter patter any fault had to go to earth through long arc spaces an from panel to panel. He had no wish to say anything again the B.E.S.A. panel, his desire being simply to stabili matters.

Published Specifications.

Compiled expressly for this journal by Patent Agents.

The name of the applicant's patent agent, if any, will be found on the print specification.

The numbers in parentheses are those under which the specifications will printed and abridged, and all subsequent proceedings will be taken.

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24,901. "Holders for thermionic valves for use in wireless systems." G. A. Mitchell. October 6th, 1923. (226,895.)

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